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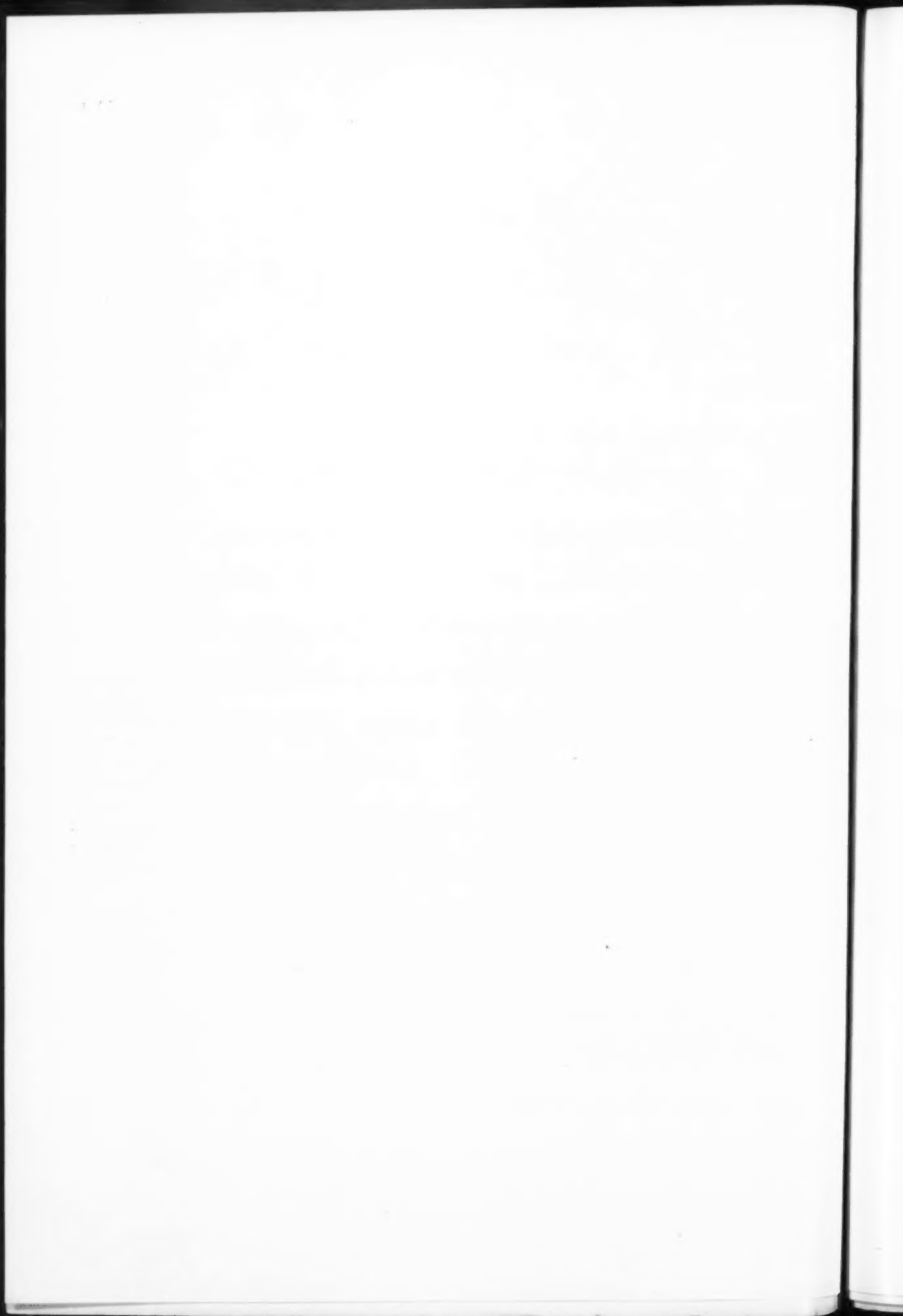
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# ARCHIVES OF PHYSICAL THERAPY, X-RAY RADIUM

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## WILL SUPERSOFT ROENTGEN RAYS (1.5-2. A. U.) REPLACE THE ROENTGEN RAYS (0.177-0.30 A. U.) ORDINARILY USED IN THE TREATMENT OF SKIN DISEASES?\*

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Numerous articles have recently appeared reporting observations and investigations of the use of roentgen rays of extremely long wave lengths. This very soft roentgen radiation has particularly aroused the interest of dermatologists because of its therapeutic possibilities in the treatment of superficial skin conditions.

As far back as 1905 Wehnelt and Trinkle<sup>1</sup> generated soft roentgen rays by the use of slow cathode rays from hot-lime cathodes excited by voltages of from 400 to 1000. Seitz also produced roentgen rays with voltages ranging from 400 volts to 900 volts. Dember in 1911 and Whiddington in 1912 were able to detect x rays from the use of potentials of from 130 to 250 volts. In July, 1913, Dember<sup>1</sup> lowered the voltage to 18.7 and calculated that the roentgen rays produced had a wave length of  $7 \times 10^{-6}$  cm. Schultz<sup>2</sup> and Zehden<sup>3</sup> in 1910

used roentgen rays produced by about 15,000 volts for the treatment of skin diseases. Stern, in this country about that time, also employed soft roentgen rays for therapy. Following Schultz' early death, interest in supersoft roentgen rays remained quiescent until 1925 when Bucky<sup>4</sup> called attention again to the therapeutic possibilities of very long wave length rays. In his reports he employed voltages ranging from 7,000 to 10,000, and utilized hot cathode vacuum tubes with Lindemann glass windows. This tube is constructed on the same principle as our present Coolidge roentgen ray tube. Since Bucky's articles have appeared, numerous other workers have investigated this subject. Among them are Gabriel<sup>5</sup>, Martenstein and Irrgang<sup>6</sup>, Mannheim-er<sup>7</sup>, MacKee<sup>8</sup>, Fuhs<sup>9</sup> and others.

### PHYSICS

In reviewing the literature which has appeared on this subject since 1925, there have been some differences of opinion regarding the status of rays produced by voltages of from 5 to 10 Kv. Bucky<sup>10</sup> sets them aside as a separ-

\*Read by invitation at the Sixth Annual Meeting, American College of Physical Therapy, Chicago, Nov. 31, 1927.

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ate radiation with a place in the spectrum between the ultra violet and the roentgen rays. He says that, "These rays are electromagnetic oscillations (infra-roentgen rays) of a wave length of about 1.5 to 2 Angstrom units. They are characterized by their small penetration power, so that almost all of their energy is absorbed by the tissues, e. g.; skin of about 2 mm. thickness." He calls them borderline or "Grenz" rays. Robertson<sup>11</sup> (0.06-500) and Bachem<sup>12</sup> (0.05-725) give the roentgen ray spectrum as ranging between 0.05 Angstrom units and 500 Angstrom units or more. Failla<sup>13</sup> says that electromagnetic vibrations of 2 Angstrom units wave length fall well within the range of roentgen rays and that they have all the physical properties of ordinary roentgen rays. This coincides with an opinion previously expressed by Pusey.<sup>14</sup> Gabriel and Martenstein both agreed that the rays used by Bucky were roentgen rays of long wave length and that they could see no reason for setting them aside as a new radiation. One of us (E.-<sup>15</sup>) investigating the penetration power of rays produced by 8 Kv. with a Mueller tube obtained photographs of metallic objects through a filter of one millimeter of aluminum. The other factors were 8 M. A. distance 6 cm. and time 4 minutes. The photographs produced were much clearer when taken through filters of  $\frac{1}{4}$  and  $\frac{1}{2}$  mm. of aluminum, but the time exposure required could be reduced to 5 seconds for the  $\frac{1}{4}$  mm. of aluminum and 1 minute for the  $\frac{1}{2}$  mm. of aluminum. A clear photograph was also taken through  $\frac{1}{4}$  mm. of aluminum in 30 seconds at a distance of 15 cm. from the central part of the target. Therefore, part of the beam of the rays produced with a voltage of 8 Kv. can easily penetrate into the cutis.

Electromagnetic vibrations having a beam of rays with a large percentage of wave lengths ranging from 1.5 to 2 Angstrom units are produced by voltages below 10 Kv. A special tube is used which simulates the Coolidge x ray tube in many ways, with certain modifications such

as a Lindemann glass window which latter permits these long waves to pass through and which ordinary soda glass does not. This tube also has an anode in the shape of a cone built into its walls. The tube is water-cooled and unipolar. At a distance of 6 cm. from the center of the target to the skin, an area the size of a silver dollar may be treated while at a distance of 10 cm. the area may be slightly over three inches in diameter. The apparatus for exciting this tube is inexpensive and easy to operate.

### BIOLOGY

The biologic<sup>16</sup> effects of supersoft roentgen rays differ in some respects from the harder roentgen rays because of the high absorption coefficient of the former. The differences observed have been; that the supersoft rays may produce an erythema instantaneously; the pigmentation which follows its use is greater; with marked erythema doses no epilation occurs; pinpoint vesicles and larger ones may appear following double erythema doses; the penetration is very much less and a very early leucocyte drop occurs with a rapid return to normal. Supersoft roentgen rays simulate the ordinary roentgen rays in that they both have latent erythemas; each may have pain following marked erythema doses; and both are cumulative in effect. Latent erythemas of from two to four weeks have been observed with this supersoft radiation.

### THERAPY

The writers have had under their observation various (35) skin diseases which were treated by the use of roentgen rays produced with the Mueller tube with an apparatus similar to that used by Bucky. The factors usually used were 8,000 volts, 8 milliamperes and 6 cm. distance from the center of the target to the skin. As a working basis a standard unit of dosage was adopted. One unit was considered the erythema which appeared on the exposed flexor sur-



face of an extremity of a young brunette adult during the first 24 hours using the above factors. The time exposure necessary for this was about three minutes. Most diseases required one to two unit doses for an improvement or a cure. The following diseases responded favorably—dermatophytosis, seborrhoeic dermatitis, basal cell epitheliomas, perleche, dermatitis herpetiformis, lichen planus hypertrophicus, sarcoid, keratoses, neurodermatitis and certain cases of sycosis vulgaris. One case of folliculitis decalvans showed a good result.

Less favorable results were obtained in a few cases of tinea capitis, acne vulgaris, angioma cavernosum, keloids, leukoplakia of the tongue, pruritus ani and vulvae, rosacea, tuberculosis verrucosa cutis, verruca vulgaris, erythema induratum, lupus erythematosus, herpes zoster, and dermatitis venenata.

No improvement was found in the treatment of psoriasis, lupus vulgaris, scleroderma, xanthelasma, perifolliculitis abscedens et suffodiens, urticaria pigmentosa, clavus, parapsoriasis and dermatitis papillaris capillitii.

The most strikingly favorable results were obtained in epitheliomas involving the eye lids. The above conclusions were drawn from the treatment of a limited number of each disease, which numbers will have to be increased considerably in order to collect more valuable clinical data. It is hoped that many new workers will come into this field in order to contribute their observations and to determine the true value of therapy with supersoft roentgen rays.

MacKee<sup>8</sup> gives a broad bibliography of this subject, with photographs, and diagrams of the special tube and apparatus.

<i>Favorable Results</i>	<i>Less Favorable Results</i>
Epitheliomas of eyelids	Tinea capitis
Dermatophytosis	Acne vulgaris
Seborrhoeic dermatitis	Angioma cavernosum

Basal cell epitheliomas	Keloids
Perleche	Leukoplakia of tongue
Dermatitis herpetiformis	Pruritis ani
Lichen planus hypertrophicus	Pruritis vulvae
Sarcoid	Rosacea
Keratoses	Tuberculosis verrucosa cutis
Sycosis vulgaris	Verruca vulgaris
Folliculitis decalvans (1 case)	Erythema induratum
Neurodermatitis	Lupus erythematosus
	Herpes zoster
	Dermatitis venenata

#### *Poor Results*

Psoriasis	Urticaria pigmentosa
Lupus vulgaris	Clavus
Scleroderma	Parapsoriasis
Xanthelasma	Dermatitis Papillaris
Perifolliculitis abscedens et suffodiens	capillitii
	Lupoid sycosis

#### CONCLUSIONS

1. Electromagnetic oscillations produced by voltages between five and ten kilovolts are roentgen rays of extremely long wave lengths. In the beam of these rays there is a high percentage of wave lengths between 1.5 and 2 Angstrom units.

2. These rays have physical properties which are similar to those of the roentgen rays ordinarily used, fall well within the x ray range, and should not be set aside as a different radiation.

3. The term "supersoft" roentgen rays seems to be the most explanatory as well as the most convenient term to use for rays having a wave length of about 2 Angstrom units.

4. With eight kilovolts sequelae have not been observed after two years, which indicates a greater degree of safety than is found with the use of harder roentgen rays.

5. While roentgen rays of extremely long wave lengths can be expected to have a greater degree of safety than the rays of wave lengths

commonly used, the writers can not say that these rays are entirely harmless for as yet a long enough time has not elapsed to say positively that there will be no sequelae.

6. Supersoft roentgen rays (2 Angstrom units) will ultimately find a limited place in the treatment of skin diseases, but the writers do not feel from their observations to date that they will replace the roentgen rays that have been ordinarily used.

#### REFERENCES

1. Quoted from G. W. C. Kaye: *X Rays*: Longmans Green & Co., London, 1914, p. 119.
2. Schultz, Frank: *Die Roentgentherapie in der Dermatologie*; J. Springer, Berlin, 1910.
3. Zehden, A.: *Atypische und weniger belsannte Folgeerscheinungen nach Rontgenbestrahlung*, Berlin Klein Wchnschr., 1910, XLVII, 16-18.
4. Bucky, G.: *Reine Oberflächentherapie mit überweichen Rontgenstrahlen*. *Munchen. med. Wchnschr.* 1925, LXXII, 802-806.  
Bucky and Mueller. *Strahlende Energie, Haut und autonomes Nervensystem*. *Munchen. med. Wchnschr.*, 1925, LXII, 883-885.
5. Gabriel, G.: *Fortschr. a. d. Geb. d. Roentgenstr.*, 1927, pp. 72-74; *Strahlentherapie*, 1927, Vol. 24, 534; *Ibid.* 1927, Vol. 26, 189.
6. Martenstein and Granzow-Irrgang, D.: *Strahlentherapie*, 1927, 26, 162.
7. Mannheimer, O.: *Fortschr. a. d. Geb. d. Roentgenstr.*, (July) 1927, p. 73.
8. MacKee, G. M.: *X Rays and Radium in the Treatment of Diseases of the Skin*; 2nd Ed., Lea and Febiger, Philadelphia, 1927, p. 749-759.
9. Fuhs, H.: *Über die Behandlung von Hautkrankheiten mit Buckys Grenzstrahlen*, 1927, Vol. 26, pp. 657-674.
10. Bucky, G.: "Grenz" (Infra-roentgen) Ray Therapy, *American Journal of Roentgenology and Radium Therapy*, Vol. 17, p. 646, June, 1927.
11. Robertson, John K.: *X Rays and X Ray Apparatus*; MacMillan, New York, 1924, p. 143.
12. Bachem, Albert: *Principles of X Ray and Radium Dosage*, p. 95, published by Albert Bachem, 1923, Chicago.
13. Failla, G.: Discussion before New York Roentgen Society, at N. Y. Acad. of Med., October 17, 1927.
14. Pusey, Wm. Allen: Discussion of paper read by Eller and Bucky at annual meeting of A. M. A., section on dermatology, May, 1927 (see 15).
15. Eller, J. J., and Bucky, G.: "The Grenz (Infra-roentgen) Rays in Dermatology, a Preliminary Report of Clinical and Biological Observations Read at the Annual Meeting of the American Medical Association, Section on Dermatology, May, 1927. Published in *Archives of Dermatology and Syphilology*, December, 1927.
16. Eller, J. J.: *Supersoft Roentgen Rays in Dermatology*, *American Journal of Roentgenology and Radium Therapy*, November, 1927.

## THE ROLE OF ROENTGENOLOGY IN DISEASES OF THE CHEST

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The importance of roentgenology in diseases of the chest is second only to the role played by the x ray in diseases of the gastrointestinal tract; for while in chest pathology the clinician, by inspection, palpation and auscultation, gains knowledge of sufficient import to establish or quasi-establish an accurate diagnosis, the symptomatology of gastro-intestinal diseases is at times so conflicting as to make a diagnosis almost impossible without the aid of roentgenology; yet the chest lesion may be so situated as to be beyond the reach of the stethoscope, however experienced the clinician might be, or of such nature as not to elicit physical signs, or these signs may be so misleading as to leave a reasonable doubt of the cause producing them.

In order to fully comprehend the meaning of the different shadows cast upon the x ray film the physician should be well acquainted with the degree of x ray absorption of a given tissue; secondly, the pathological changes possible in the organs to be examined, and last (though not least) the anatomy and physiology of the organs shown on the skiagram. Once that the normal shadows have been observed and their meaning understood then one can conceive the variations from a physiological into a pathological state. No matter what pathological conditions you may choose it is impossible to give an equal description of the same in all cases for the simple reason that no two lesions are, histopathologically speaking, alike; hence they, necessarily, cast different shadows upon the skiagram. We have been reading annually for the past twelve years hundreds of films taken of patients suffering from pulmonary tuberculosis and we have yet to see two of these roentgenograms exactly alike.

To try to discuss fully in a single lecture the many diseases of the chest in which the x ray furnishes helpful data is next to impossible. I will, therefore, discuss as fully as the time will permit, the most frequent pathological entities calling for roentgen help; but before I enter into the subject it would be well to speak of the technology of chest radiography. A radiogram of almost any part of the human anatomy may be poor within reasonable limits, in photographic merits, and yet be diagnostic. This, however, does not apply to chest radiography. Here we have no happy medium. A chest radiograph must be 100 per cent perfect, lest we chance an erroneous diagnosis. This end result, I am sure, can be obtained with different technics, but certainly the most beautiful stereogram of the thorax is not always and necessarily diagnostic.

In taking an x ray of the chest for the study of the lungs one must remember that the most delicate of all human tissues is being rayed. A good radiogram of the lungs for early lung pathology should not show the ribs behind the heart shadow, for if the voltage producing the x ray beam is so high as to penetrate through the heart muscle it certainly must go through delicate congestive and exudative areas, on the reproduction of which may depend the final diagnosis. In my laboratory our technic is decided upon after the fluoroscopic examination. Every chest should be fluoroscoped, not only to study the mechanics of respiration but also to observe the action of the heart, the condition of the mediastinum, the behaviour of a mass, the study of fluid levels, etc. An old case of tuberculosis, with long standing pleuritic changes and where cavities are to be studied, certainly requires a technic much different than when early pulmonary tuberculosis is suspected and sought after. It is my belief, backed up by actual ex-

\*Read at X Ray and Physical Therapy Meeting, Kansas City, August 30, 1927.

perience, that with the proper technology an early pulmonary lesion will be revealed in a stereogram much before physical signs make their appearance, but much after the constitutional symptomatology has directed the clinician's attention towards tuberculosis. We take all of our chests in the standing position. Many lesions situated in the lowest portion of the lower lobe have been overlooked by x raying the patient in the prone position, the elevation of the diaphragm overshadowing the pathologic process. We prefer the 7-foot distance, not only because it increases the photographic detail, but also it reveals the pathology in its natural size. A tube shift  $5\frac{3}{4}$  inches is used to make up for the increase in distance. We do not use the "flash" technic, ranging from  $1/10$  to  $1/20$  of a second. This technic undoubtedly gives prettier radiograms, but inasmuch as every shadow appears clean-cut it has been my impression that they have not the same diagnostic value as those taken with a longer exposure, say  $\frac{1}{4}$  of a second time, which permits of a certain amount of cardiac vibration to the lung tissue which, in turn, produces blurredness where blurredness belongs, and cleancutness in those lesions that represent dry pathologic changes.

The many laboratories in which I worked during my army experience afforded me an opportunity to become acquainted with different makes of x ray transformers, and it is my belief that insofar as good x ray work is concerned any transformer will do, provided the current is properly stabilized. Good work cannot be obtained from a laboratory not equipped with a stabilizer.

I feel that there is no need of going into detail as to dark room technic, the importance of which is well understood by anyone in x ray work, however inexperienced. We all know that accuracy in the operating room will mean nothing if the most careful dark room technic is not carried out.

The reading of chest conditions by means of flat plates is a past performance. Flat plates are used only in emergencies, where the gravity of the case or other special circumstances will not permit of a stereoscopic study. Stereoscopic plates are a necessity since they give us the location and the depth of the pulmonary lesion and the differentiation between pulmonary and pleural, or extra-thoracic conditions. In tuberculosis especially they resolve for us the shadows into their components and thus give us a truer idea of the density of the infiltration, and finally, in the average case they furnish the clue whereby the roentgenologist is able to inform the clinician of the relation between the thoracic wall and an area of infiltration.

It has been my experience that practically 90 per cent of the patients coming to the roentgenologist for examination of the chest are either suffering from or suspected of suffering from pulmonary tuberculosis; therefore we will discuss this disease first of all. The value of roentgenology in pulmonary tuberculosis, we maintain, is prognostic rather than diagnostic. Let it be understood, however, that this does not mean that the science of roentgenology lacks diagnostic value in pulmonary tuberculosis, but that in this respect it ranks second.

Although pathologists are in full accord as to the pathological changes that take place in pulmonary tuberculosis no two of them agree in the classification of the different types. Some will classify the disease according to the supposed mode of infection, while others will speak of the different types, taking into consideration the pathological course of the lesions. We, personally, in studying the different types of pulmonary tuberculosis, do not like to speak of them in what seems to be theoretical terms, because in spite of the fact that it is a logical factor in tuberculosis that infection may take place by direct inhalation of toxic material, or through the blood or lymphatic channels, we feel that

in the interpretation of x ray findings it matters not in which way the organism entered the tissue; so that for the purpose of x ray study we will divide pulmonary tuberculosis into three main types: Miliary, chronic ulcerative and chronic fibroid.

Miliary tuberculosis is the acute form of pulmonary tuberculosis in the adult. No doubt you have all seen gross specimens of organs affected with this type of disease and in your mind is still alive a vivid picture of those small, grayish, translucent areas scattered in myriads throughout the lung substance and representing the miliary tubercles imbedded in the perivascular connective tissue, and distinguished from the characteristic conglomeration of tubercles seen elsewhere not alone by their minute size, but by their irregular configuration. When a fresh cut is made in a miliary lung and the tissue is gently squeezed a certain amount of exudation is seen oozing out from the margins of the tubercles, which, as you well know, are of a semi-solid consistency. Now, what will you expect that the x ray will show; what is there to intercept, to absorb the rays in addition to the bony structure and the mediastinal organs (the heart included)? Only the normal structures of the lung, made up mainly of connective tissue, viz. bronchi and blood vessels, and the miliary tubercles; hence you will have before you a radiogram showing numerous minute areas of hyper-density varying in size and shape, and of somewhat irregular outline, scattered in between the linear markings of the bronchial tree, evenly and symmetrically distributed throughout the field, reaching the periphery. In these cases the pleura is uniformly inflamed, congested, engorged, so that it absorbs evenly throughout both fields a certain amount of radiation, giving to the radiogram a peculiar blurredness similar to that seen in a photographic film when the object photographed moves slightly. The costophrenic angles are seen occluded, not by adhesions; they are occluded simply because of incomplete ex-

cursion of the diaphragm, the result of reduced expansion of the lungs.

On the other hand, bring to your mind for a moment the changes that take place in a case of chronic ulcerative tuberculosis. Like all chronic processes it has a beginning. It starts in a given area, usually—not necessarily—in the uppers, most commonly just below the clavicle near the periphery, sometimes at the very apex, seldom at the lower portion of the uppers and rarely, very rarely we might say, at one of the bases. It is said that the preference of the disease to start at the uppers is due not only to the fact that this portion of the lungs is less vascular than the lower portions, but also because of their short excursion, or motion, and a subsequent slow gas interchange. The primary lesion consists of scattered tubercles surrounded by a pneumonic exudate in a congested area; in other words, and grossly speaking, we have an area where fluid is accumulated in the tissues, because exudate and congestion means fluid. Therefore, when the radiogram is made this collection of fluid will intercept radiation and the infiltrated area will cast upon the plate a dense shadow of various densities, dependent upon the quantity of fluid stagnant in different places—and sizes in accordance with the extension of the lesion. As the disease advances and caseation takes place the shadows coalesce, the pathologic consolidation over small areas being revealed in the skiagram by denser areas, more or less spherical in shape, within the dense area of infiltration. Farther on either through the blood or lymphatic channels or else by the discharge of caseous material into the contiguous bronchi and its aspiration into the other parts of the lung, unless the case is non-progressive, the infection is bound to invade the opposite side and the adjoining lobes and then we see in the gross pathological specimen in addition to the inflammatory area, previously described, numerous isolated tubercles in the adjoining lung parenchyma. These cast upon the radiogram the mottled shadows so often spoken of.



A word about mottling: Occasionally we venture in our reports to speak of "mottling of long duration" and "mottling of recent origin." Post mortem findings have taught us to recognize, with a certain percentage of error of course, the mottling of long standing, which casts on the films round, clean-cut, hyperdense shadows—the hyperdensity being due to a certain amount of calcific degeneration—in contrast to the soft, faintly dense shadows, of blurred outline, cast by tubercles surrounded by a layer of pneumonic exudate, the result of recent infiltration.

After the process of infiltration is well established, when the physiological functions of a given area are being lost, when there is no longer gaseous interchange, when there is hindrance to the capillary circulation and there is a likelihood of exudative decomposition, breaking down of the lung tissues begins to take place and the skiagram offers areas of rarefaction of increased radiability, through which the rays penetrate easily. These areas are irregular in conformation and are seen in the midst of hyperdense zones; they are not as yet cavities, but they are going to be unless the disease is arrested at this stage. They mean disintegration and softening of the parenchyma. This softening and disintegration has been observed by us in cases far established usually, because cavitation, gentlemen, is the result of disintegration and there cannot be disintegration at the first stage of a tuberculous infection. If at this stage the process does not go on to ulceration reparative changes take place in the form of connective tissue cell proliferation, so that when the healing is completed then the areas of rarefaction are supplanted by areas of hyperdensity which show themselves on the plate in the form of blurred, blotted-out, dense areas with little, if any, lung markings, characteristic of diffused fibrosis; but if the ulcerative process proceeds it will eventually lead to a most characteristic lesion of the tuberculous lung—the cavity.

Cavities are formed either through the pressure of retained secretions within disintegrated and softened portions of the infected lung parenchyma or to liquification of caseous areas not in connection with the bronchial trunks. In the former case we will see, in serial roentgenograms, first a change in the density of the shadow from rarefaction to hyperdensity, due to the absorption of the rays by the retained secretions, and in the majority of cases to a marked rarefaction just as soon as a communication is established between the cavity and the neighboring bronchi and drainage takes place, there not being any fluid to intercept the rays. In the latter, however, no change in the shadow will take place while the process of cavity formation is going on because caseated material will intercept radiation at the same rate that secretions will and unless drainage takes place a cavity within a caseated area may be overlooked. Once that the drainage is established, however, the area of decreased radiability corresponding to the size of the excavation will be in evidence. A single cavity may grow larger by constant ulcerative process or by the confluence of separate smaller ones. If the ulcerative process is brought to a halt the cavity is seen in the radiogram surrounded by a ring of increased density, which is the image of the capsule, made up of connective tissue, the result of reparative fibrous proliferation; the inner surface is very rough and ribbed by projecting bands, which are represented on the plate by an irregular, uneven internal border of the ring in contrast to those annular shadows cast by thickened pleura, which invariably have a smooth, clean-cut internal border. Cavities, as the pathological changes of their formation imply, seldom assume a circular shape; they are, more or less, irregular in shape because of the well known fact that certain constituents of the lung tissue resist ulceration and destruction much more than the adjoining ones. The only exception that can be made to this rule in visible cavities of tuberculous origin are those of long standing which are



surrounded by indurated lung tissues and often assume an annular shape.

Chronic ulcerative tuberculosis may become arrested even in unbelievably advanced cases, the gross lesion undergoing healing by fibroid proliferation and tubercle calcification, this condition being shown on the plate by the hyperdense mottled shadows of clean-cut borders, already spoken of, and the irregular shadows representing the diffused fibrosis. Cavities once produced are there to stay so that in a well arrested case they are visualized in the same manner as during active disease, altho they usually shrink and therefore cast shadows denoting smaller areas of rarefaction.

Fibroid phthisis, or chronic fibroid pulmonary tuberculosis, is characterized (from a pathological point of view) by an early fibroid degeneration concomitant and following step by step the infection of the organ, so that in the early stages of the disease the caseous areas would be found surrounded by a capsule of fibrotic tissue, forming a wall separating the diseased portion from the neighboring healthy lung tissue. The capsule contracts and shrinks and the caseous material within it has a tendency to early calcification, or else the tuberculous infection may be more or less generalized and consist of minute foci scattered throughout both lungs; then the fibrous tissue proliferation may intersperse the minute foci so that both lungs may show a considerable amount of sclerotic tissue, in the form of wide, fibrous bands, extending from the hilus, through the organ, to the periphery, occasionally causing true deformity of the thoracic contents. Fibroid tuberculosis is shown in the x ray either by linear markings in reticular formation encircling here and there irregular areas of hyperdensity, early of caseative, later of calcific nature, or else by heavy, dense, ribbonlike linear markings radiating from the hilus to the periphery. Ever so often cases of fibroid phthisis are seen exhibiting all the changes just described.

#### *Non Tuberculous Pulmonary Diseases.*

Bronchiectasis can clinically be mistaken for tuberculosis if the retained bronchial secretions are highly toxic, giving rise to loss of weight, fever and nightsweats. Not until recently was the x ray of any help to the clinician here but the work of Forastier in France, so brilliantly carried out in this country by Pritchard and others, has made the x ray a very valuable adjunct in the diagnosis of these cases. I refer to the injection of iodized oil into the bronchial tree, the technic of which, however dramatic, is far from being difficult. The pocketing, the result of multiple dilatation of the bronchi, can be demonstrated in a most convincing and spectacular manner. Lipiodol is also injected into the bronchial tree in cases of suspected bronchial obstruction.

Unresolved pneumonia foci often puzzle the roentgenologist as to their etiological meaning and unless clinical data is forthcoming they cannot be differentiated from caseative tuberculous broncho-pneumonia.

Quite frequently a cardiac case is labeled tuberculous because of hemoptysis and unless the roentgenologist is on guard and studies the heart action in every chest case that comes to him he is liable to mistake the mottling caused by pulmonary hypostasis for the mottled shadows cast by a tuberculous process. Again, it is well to be reluctant in making a diagnosis of miliary tuberculosis from the x ray alone. The first stage of pneumoconiosis at times gives identical x ray findings.

Prior to the autopsy investigations of Asmann and myself pleural annular shadows were considered pathognomonic of pulmonary tuberculosis but our present knowledge leads us to believe that any pulmonary process of a chronic or subacute nature, that is near enough to the periphery, may give rise to these pleuritic changes. Pulmonary abscess casts a dense shadow of uniform density and fairly well defined borders,

the location of which seems to depend upon whether the infection has taken place by the inspiration of infected material, in which case they can occur anywhere in the pulmonary field.

*Mediastinal Adenitis.* Acute inflammation of the glandular structures of the mediastinum is rare and essentially a non-tuberculous condition. It is shown in the skiagram by an increase in density and size of the mediastinal shadows. If the case goes on to abscess formation the resulting mediastinal empyema may be easily seen behind the heart shadow, in the form of a triangular dense shadow with the base downward. Obviously, a technic of greater penetration, so as to go through the heart muscle, should be used. The chronic mediastinal adenitis may or may not be tuberculous as it also may be a sequela of the exanthema, whooping cough, or accompany any infection of the upper respiratory tract. In children tuberculosis, unless of the miliary type, starts at the hilus glands, but the diagnosis should not be made from the x ray findings alone.

There are certain forms of non-tuberculous parenchymatous lesions the true etiology of which is not well understood. Contrary to tuberculosis, however, the areas of mottling are usually situated at the base in the neighborhood of the descending bronchial trunks, as if the

lesion had been caused by inhalation of infectious material.

*Mediastinal tumors and aneurisms.* A dense shadow projecting from the mediastinum, showing no loss of continuity from the aortic shadow and exhibiting under the fluoroscope expansive movements synchronous with the cardiac action, is probably an aneurism but if the expansive movement is absent one cannot discard the diagnosis of aneurism because quite often nature in its effort to reinforce the yielding arterial wall forms a heavy coat of organized blood clots, which prevents pulsation. In my experience there is only one way of differentiating non-pulsating aneurisms from mediastinal tumors and that is by serial roentgenography, which will show the rapid growth of the latter.

*Heart.* True clinical roentgenology cannot be practiced unless the clinician and roentgenologist march hand in hand. This is especially true in heart conditions. Indeed, the help furnished by the x ray goes beyond the demonstration of the size of the heart. By means of a technic published by this writer in the Journal of the A. M. A. in 1921 we can demonstrate the increase in volume of the different cardiac chambers and thus derive conclusions as to certain lesions and the existence of toxic conditions producing cardiac disorders.

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## TREATMENT OF CANCER OF THE CERVIX\*

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That the incidence of cancer is actually on the increase, there is no doubt.

The general public and many physicians have a doubt as to the curability of cancer in any stage.

Though we have no definite knowledge as to the cause of cancer, we do know that chronic infections of the cervix, which subject the tissues to chronic irritation, are precancerous factors. We also know that cancer begins as a local lesion which one time in its clinical course is amenable to treatment. It may be treated by surgery or electrocoagulation or it may be destroyed by radium or x ray.

The treatment of cancer of the cervix presents one of the big problems of today and is of interest not only to the profession but to the laity as well. Shall it be treated by radical operation or by radiation, or by a combination of surgery, radium, and post operative x radiation?

Unfortunately, early cancer of the cervix is a rare finding because the majority of patients do not present themselves for examination until the disease is fairly well advanced. Hence our efforts must be toward prophylaxis—that is, the cure of precancerous lesions such as infections and traumatism of the cervical tissues.

Usually when first seen by the physician, the lesion has passed beyond the incipient stage because bleeding, which to the patient is the alarming symptom, means that the tissue has already begun to break down and superficial necrosis has taken place.

A fairly similar condition prevailed for many years in the treatment of tuberculosis, but by organized propaganda and proper education of both the profession and the public, it has been demonstrated that tuberculosis is amenable to treatment and is curable. So, also, is cancer, if it can be discovered in the initial stage when it is a simple, localized growth.

It must be conceded that if a permanent cure is to be obtained in carcinoma, either by means of radiation or operation, the treatment must be carried out in the early stage.

According to Schmitz of Chicago the cases that present themselves for treatment fall into one of four groups:

1. A clearly localized, simple growth, the primary ulcer or nodule, with no extension or infiltration into the surrounding cervical tissues.
2. The nodule or ulcer with beginning infiltration of the surrounding cervical tissues, but which has not extended beyond the confines of the cervix.
3. Growths with infiltration of parametria. This can be recognized by examination per rectum.
4. Cancer of cervix with extensive ulceration, necrosis and infiltration of surrounding tissues with sepsis, hemorrhage and cachexia.

In the first group, with the initial, local lesion, a simple hysterectomy will remove all the growth. This can be treated by operation and can be treated equally well by radium without all the danger incident to an anesthetic and operative trauma.

Of the second group the same may be said as of group one.

\*Read at X Ray and Physical Therapy Meeting, Kansas City, August 30, 1927.

In group three where the para metria has been infiltrated more can be expected from radium followed by deep x ray therapy, than can possibly be expected from surgery. A wide pan-hysterectomy popularized by Wertheim has not proven successful because of the high primary mortality and the small percentage of cases (35 per cent) suitable for operation.

The results of operation in the third group, and more especially in the fourth group, have been so disappointing that it has been practically abandoned in favor of radiation.

Figures are very unreliable, owing to the personal factor of the skill of the operator, differences in pathological reports, methods of classification, etc., but at least radiation statistics are as reliable as surgical statistics. The accumulated evidence points to the fact that cancer of the cervix should always be treated by radiation except in the early localized case, where either treatment yields equally good results. Surgeons may take exception to this statement on the ground that no treatment is good treatment which does not yield material for pathological study. This is a reasonable point and worthy of discussion. Surgical treatment permits of careful study of the entire tissue, yet it will be admitted that very few physicians are capable of properly interpreting microscopical tumor pathology. It is not intended to belittle the value of tissue study, but the percentage of error, as it is done in the average hospital, is probably as great as in clinical observation alone. This is in no sense a reflection on the pathologist, but indicates the difficulty of tissue diagnosis.

It is considered entirely proper to remove a section of tissue for microscopical study in every case where there is doubt of the diagnosis, whether the treatment is to be operative or radiative. This should be done very carefully, probably with the hot knife if surgery is

contemplated, or at the time of treatment if radiation is the method of choice.

Tissue examination should do more than make the diagnosis of cancer; it should classify the tumor according to degree of malignancy, based upon the cell type, fibrosis and hyalinization. These factors will aid greatly in making a prognosis.

Radiologists have been criticised for treating lesions of the cervix without making routine tissue examinations and an effort should be made to overcome this whenever there is the slightest doubt of the diagnosis. It is difficult to see where tissue sections could be of value either in diagnosis or prognosis in advanced cases. It must not be forgotten that the interests of the patient are paramount to the interests of pure science and if no information of value can be gained by tissue section, such routine practice for the sole purpose of proving the diagnosis is probably taking unwarranted liberties with the patient.

In this connection it is well to consider the proper method of examination of cancer of the cervix. Very frequently it happens that a patient is examined by three or four doctors before having treatment. The family physician makes the first examination and possibly being in doubt as to the diagnosis, or fearing to tell the patient the truth without consultation, refers her to another physician. As a rule she is next sent to the surgeon who makes another examination. If the condition is inoperable, the patient is then referred to the radiologist who necessarily has to go through the same procedure. Oftimes the patient will go to several physicians of her own accord to substantiate the diagnosis before she is willing to undergo treatment. Such practice should be condemned because rough or frequent handling of the cancer may break down nature's protective wall in the same manner that massage or squeezing a furuncle spreads the infection.

The examination of women suspected of having cancer of the cervix should be done very carefully. First, a digital examination is made of the vaginal vault and the cervix. Second, the finger is inserted into the rectum and the pelvis explored as high up as possible. Third, the vaginal speculum is inserted and the parts carefully inspected. The knee-chest position is very practical as the cervix can usually be inspected to good advantage with no trauma.

If a lesion of the cervix is found the outer limits of the disease are determined. If the lesion is confined entirely to the cervix the examination may be stopped until such time as it is practical to remove a section for microscopical diagnosis.

Cervical erosion is sometimes difficult to differentiate from cervical cancer. Bowing states that in cancer the line of demarcation between the lesion and the normal tissue is very sharply defined, whereas in cervical erosion the lesion gradually fades off into the normal tissues. Superficial capillaries are quite prominent in cancer at the edge of the lesion. In a fungating growth the diagnosis is rarely in doubt.

If the lesion is one in which radium is indicated, the position, size and direction of the cervical canal are noted so that the proper applicator may be made up ready for insertion.

The treatment is conducted with as little fuss as possible. The lower bowel is emptied by enema, the bladder emptied and a sodium bicarbonate douche given. The patient is put in the position best suited to expose the lesion, either the knee-chest or the dorsal, and the radium applicator placed. It is desirable to insert the radium into the cervical canal, but if this is productive of too much trauma, it may be packed against the cervix. The vaginal vault is then packed to push the bladder and rectum

away from the radium. During the treatment the bladder should be emptied at least every four hours; the horizontal position and the large vaginal pack will necessitate the use of the catheter in many cases.

The dosage may vary from 2000 to 5000 milligram hours, depending upon the extent of the lesion, the location and type of applicator and the size of the vagina. The radium should be well filtered through at least one millimeter of copper, silver or lead, plus the rubber catheter. Most operators use 50 to 100 milligrams of radium, the amount makes no particular difference in the result. It is well to deliver the entire dose as soon as possible, making not more than three applications usually, all within one week.

The radium treatment is supplemented with x ray treatment which we shall discuss with the picture to say that either one alone should not be depended upon. The radium is applied for the destruction of the local lesion and the x ray for the control of extension into the parametral structures.

The extent of the growth will, of course, determine the prognosis more than any other factor. It is quite obvious that a small localized cancer of the cervix will be more amenable to treatment than one that has invaded the parametral structures. Many cases are so far advanced that they are incurable by any type of treatment yet devised, but the palliation of symptoms, such as pain, hemorrhage, odor, loss of weight and strength, fully warrants the radium treatment.

(Motion picture films were then shown illustrating pathology of various types of carcinoma of the uterine cervix and methods of treatment by radium and x ray.)

#### DISCUSSION

DR. SOUTHARD, (Fort Smith, Arkansas): As I listened to Dr. Donaldson's paper I was very forcibly re-



minded of what I heard Dr. Kelly of Baltimore say two years ago in Chicago. I suppose you all know Howard A. Kelly, who was so long at the head of the department of gynecology of Johns Hopkins Hospital. He said for forty years he treated cancer of the uterus surgically, for ten years he had treated it by radiotherapy. He said, "I do not intend ever to treat it surgically again." The reason for this is that when treated surgically there is a very considerable death rate, there is hospitalization, pre-operative treatment and post-operative convalescence, and mutilation sometimes. When treated radio-therapeutically we have none of this, we have no death rate, no hospitalization, no pre-operative treatment, and no post-operative convalescence; and he said when results are considered, leaving out all the deaths when treated surgically and comparing only those that survived the operation with those treated radiotherapeutically, he said his results were decidedly better than they were when he treated cancer surgically.

That struck me more forcibly, coming from a man like Dr. Kelly than anything I have ever heard or seen written and it seems to me it ought to convince us and everybody that the time for surgical treatment of these cases is about past. I have had some little experience myself and I certainly don't think a man is hardly excusable today for treating cancer of the cervix surgically if he has access to proper treatment by radium and x ray as pointed out by Dr. Donaldson.

DR. WEBB: I think we owe Dr. Donaldson a vote of thanks for the manner in which he presented his paper to us today. He has clearly shown the end result of surgery. You know the x ray man is a good deal like the undertaker in malignancy; he gets all the dead ones and if he can save five or six cases out of

every hundred he certainly has done wonders.

Dr. Donaldson spoke briefly of the results he gets in radiation. The vast majority of these malignancy cases can be materially relieved of pain and suffering, the life lengthened a short time—up to a few years in some instances. It is well worth the effort.

One thing the Doctor didn't speak of, that I do want to make some remarks on. You read frequently of cases being inoperable after radiation. I don't believe any case of malignancy after radiation should ever be operated; the tissue is mighty sensitive.

DR. TYLER: I can only emphasize the points brought out by Dr. Donaldson because he presented the subject in such a thoroughly satisfactory manner. The statistics shown by the doctor are accepted generally and go without argument, so that when we think of it in that light there is no argument so far as I can see against the value of radiation treatment in carcinoma of the cervix of the uterus.

The effect on the patient is well shown by a statement which patients frequently make after having had radiation treatment. They will frequently express themselves as so surprised that there was no shock, no sensation or no general disturbance during the treatment and they could not see how any one could deliberately choose any other method of treatment if they knew about the danger.

DR. DONALDSON: I don't have anything to add except I agree with Dr. Webb that anything to be done for the patient isn't done with the idea of fixing them for surgery because surgery would not be indicated after thorough treatment with radiation; if that won't cure them, surgery is not going to help. That is sure.



## PHYSICAL THERAPY OF THE STOMACH\*

A. JOSEPH RIVIERE, M. D. P., Sc. D

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The permanent alterations of the nervous system by the toxins of digestion cause not only functional perturbations, but finish by creating organic lesions of the stomach. As dyspepsia remains for a long time latent before determining special lesions, it is advantageous to treat at an early stage, symptoms of gastric insufficiency, pareses of contractility, deviations of chemism, which compromise eupepsy and bring to serious neurosthenic cases, by perpetuating hyposthenic gastropathy, neuro-motor dyspepsia, hepatic insufficiency or hyperchlorhydria. To corroborate the action of the diet and get rid of a dangerous polypharmacy (medicamental dyspepsia) it is necessary to know how to utilize the complete scale of physical agents. As to the various gastric syndromes, there are certain affinities which I shall designate, in the following synopsis, for the physical therapy of the stomach.

*Hypochlorhydria, Apepy, Flatulence, Ectasy, Nervous Dyspepsia*—Electro-thermo-penetration, electro-static, hydro-electric, and thermoluminous baths, actinotherapy, high frequency scintillation, vibrotherapy.

*Hyperchlorhydria, Arthritic and Uricemic Dyspepsia*—Generalized D'Arsonvalization, and localized high frequency, phototherapy, diathermy.

*Ulcerous Gastritis*—Galvanization and dorso-epigastric diathermy, stimulating radiotherapy, high frequency effluves, ozonized inhalations.

*Painful Gastropathy, Gastralgia, Gastric Tabes*—Roentgenization phototherapy, galvano-faradization, diathermy, actinotherapy.

*Neoplasms*—Deep radiotherapy, diathermy, high frequency effluves, ozonized inhalations.

*Organic Decay, Anaemia by Anorexia, Cancerous Cachexy*—Radiotherapy, static bath, ozonotherapy, actinotherapy, high frequency scintillations.

*Solar Syndrome, Nausea, Retching*—Galvano-faradization of the pneumogastric, high frequency effluves and sparks, ultra violet, diathermy, radiotherapy, phototherapy.

All these treatments, friends of the stomach, manifest their value not only by the activity of the improvements obtained, but also by the prolongation of the better effects of functional restoration.

To fix the ideas, I shall study today two syndromes which are frequently observed in medical practice: (1) Pyloric Syndrome. (2) Solar Syndrome.

### PYLORIC SYNDROME

The digestive troubles, which appear several hours after meals, under the form of uneasiness, heaviness, more or less acute pain, sialorrhoea, headache, nausea, vomiting, meteorism, characterize a state of stenosis, which is always dependent on a vago-sympathetic disequilibrium and brings on spasm. The spasm is very seldom purely nervous; it is nearly always symptomatic of a pyloro-duodenal lesion.

The pyloric syndrome is found frequently in women at the menopause, and is then usually accompanied with anxiety, uneasiness, and general depression. The pain which lies a little to the right of the epigastrium, takes on the form of cramp or of burning and irradiates in the

\*Read at fifth annual meeting American College of Physical Therapy, Chicago, Oct. 21, 1926.

back and the praecordial region; it coincides with a gastric hyperacidity of fermentation, which results from food stagnation and the obstacles to its evacuation.

The pyloric syndrome also causes at length anorexia, anaemia, emaciation, loss of muscular strength and nervous depression. The pyloric patient has a wan face and complains of physical and mental incapacity, dizziness, cephalgia, palpitations, melancholy, bad sleep with nightmares.

A rapid emaciation, with a yellowish complexion, disgust for meat, dark vomiting, should suggest the presence of a pyloric cancer, which at times is rendered evident by palpation, always visible on the radiographic screen, where its lacunar image appears sometimes with marvelous clearness.

If there is only a simple ulcer, the classic transfixing pain, the hematemesis (which are often followed by melena, when there exist incontinuity of the pyloric ring), the painful burning accompanying the ingestion of certain foods, and the violent spasm following the reaction of the ulcerous process are of high value in diagnosis.

But it is important to remember here that cholelithiasis sometimes causes prepyloric contraction even in the absence of an ulcerous process: radiography can determine this etiology indispensable for the application of a rational appropriate treatment.

Gastric dilation results frequently from pyloric insufficiency and alimentary retention. It is attended by aerophagy and stomach ptosis. Eussmaul's peristaltic ondulation and Cruveilhier's hard intermittent tension are the two symptoms which indicate the struggle of the organ against the pyloric barrier. But they can manifest themselves only when the muscular coats of the stomach have conserved their

tonicity. Then the stomach will show its passive ectasy by splash and pathognomonic radiographic characteristics: transversal widening of the fundus and the semi-lunar exposure of the opaque mixture.

All the clinical varieties of the pyloric syndrome are claimed by physical therapy, which is a rational method of transition between medicinal insufficiencies and the uncertainty of certain surgical interventions. But the greatest success of my daily practice was shown in the treatment of pyloric hypertrophy (Brinton's linitis plastica) whose habitual extension to the totality of the stomach disconcerts (as is well known) the most audacious surgery. The walls of the organ, thickened, indurated and presenting the aspect of tightly woven linen (whence the denomination linitis) reduce the capacity of the stomach, the radiography of which then underlines the cylindric deformation.

Vomiting, emaciation and cachecia may simulate a cancer, although there is oftener only tuberculosis or syphilis. I have seen several cases of linitis last very long, with prolonged periods of amelioration; I believe this variety of neoplastic syndrome to be perfectly curable. At all events it is happily sensitive to the action of x rays, diathermy, high frequency scintillation.

Even in true neoplasms, whose cure seems rare, radiotherapy furnishes good results. It relieves pain, ameliorates hypochlorhydria, diminishes the size of the tumor, sterilizes the carcinomatous tissues and glands, prevents and heals peptic ulcers.

In case of a round ulcer, the roentgen rays with stimulating doses cicatrize and regulate the nodular tissue of the cicatrix; by this beneficial action there is less chance of producing an anterior pyloric stenosis or a malignant neoformation, too frequently grafted on the previous ulceration.

The elective sensitiveness of the neoformed cells to the radiations, explains why the cancerous tissue can be destroyed and sterilized by them, without any injury to the healthy cells and normal tissues. This law which clinical observations brought me to formulate in 1900 and 1903, was afterwards biologically confirmed by well-known laboratory experiments.

In order not to multiply excessively too frequent seances of x rays and to avoid radiodermic accidents, while keeping the benefits of the intensive irradiations, I intercalate daily seances of high frequency effluves. These localized scintillations check the neoplastic transformations of callous ulcers, and exert on the symptomatic process of pylorostenosis, the most favorable clinical influence.

For spasmophylic patients, who react so easily by pyloric contractures to the least excitement and overwork we possess in the ultra-violet rays an excellent sedative of their dyspepsia. For the cure of ulcers as well as for the improvement of organic gastritis, silence must first be imposed on the spasmodic conditions. The ultra violet rays and the static bath give us the means to do so.

A precious advantage of physical therapy is that of permitting us to institute a treatment which is always favorable, even when repeated examinations have not clearly indicated the cause of the pyloric syndrome. The difficult program which consists in diminishing the alimentary stasis, in overcoming the constipation, vertigo, oliguria, myosthenic atony with gastropotosis, in stopping emaciation, in regenerating strength, in provoking in discouraged patients the most notorious reactions of confidence, in restoring the vital energy by ameliorating physical tonicity, in attenuating acid fermentations, in reactivating metabolism, in disengorging the mucous membranes, all these objects can be realized by applications of integral statism, high frequency, diathermy and irradiations.

#### SOLAR SYNDROME

The Solar Syndrome frequently observed in depressed, mentally afflicted and overworked patients is often only the reflex repercussion on the celiac system (Bichat's *cerveau abdominal*) of generally old dyspeptic phenomena. Epigastralgic attacks with umbilical hyperesthesia, hypopepsia, aortic palpitations, giddiness, anguish, cardiac arrhythmia, cold hands and feet, flush of heat, spasmophilic emotivity, sleepiness after meals and insomnia with nightmares, generally characterize the solar syndrome. Simpler forms also exist, evidenced solely by sudden pangs of hunger, nauseous discomfort, swelling and by painful cramps.

Against the solar syndrome, eupeptics, antispasmodics and nervines are useless; analgesics and narcotics frankly nocive. Alkaline powders, hot drinks and diet should not be neglected, but it can be said that physical therapy has a really happy influence on the sufferings of solarrians. It is seen daily that diathermic, radiotherapeutic, phototherapeutic and electrothermotherapeutic applications appease the most violent pain, get rid of heaviness and gastric plenitude. After a period of depression will follow, for the solarrian, a period of relief and comfort.

To prevent spasmodic reactions, it is necessary to struggle against the hypotonus of the organ and to regulate the nervism of the pneumogastric and the great sympathetic. We calm thus the most exasperated trophic center. It is with moderated radiotherapy and diathermy that the curative results will be oftener obtained.

In every solar syndrome, examination by x rays shows a ptosed stomach, whose lower end descends often as far as the pubis. The contractions of its muscles are weak and tardy. This incomplete tonus and insufficient mobility are the results of the disequilibrium of the vegetative nervous system.

Nearly always, the insidiously hidden infection prepares obscurely some complications. For

that reason it will be necessary to banish from the daily diet such foods and drinks as are capable of engendering virulent toxins or irritative volatile products which infect the solar plexus, and bring on nervitic conditions, even if there exists no irritative process on the gastric mucous membrane. Thus wine and spirits, badly cooked meat, game, preserves, meat extracts, mollusks and crustacea should not be allowed at the solarian's table. The decomposition of the hydrocarbonated, fatty and albuminous substances gives rise to fatty acids, acetones, aldehydes and sulphurous products, which excite attacks and bring back again paroxysmal pains. The lacto-vegetarian diet should be adopted, in general, to avoid nocive effects of alimentary stasis, gastric distension and aerophagy on the solar plexus.

To overcome such attacks, we have recourse at first to the ultra violet, thermo-luminous irradiations and phototherapy, the patient being in dorsal decubitus. Even when there are painful inveterate reactions, tabetiform attacks, radiotherapy always shows itself frankly analgesic and spasmophobe. It also diminishes notably acid supersecretions, by acting on the nervous glandular extremities of the gastric tunic.

The heating of the stomach by diathermic thermo-penetration equilibrates at the same time modality and gastric chemism, and exerts a powerful anesthetic influence on the sensitive terminations of the vagus and the solar plexus.

In my opinion, diathermy acts especially by liberating toxins on the nerves; it regulates blood circulation by acting on the contracted smooth fibres.

This role is a peculiarly welcome one in patients afflicted with hypertension. It is known that a sense of anxiety and aortalgic symptoms are found frequently grafted and imbricated on the solar syndrome. To the functional readaptation, which follows diathermic seances, is added

a beneficial influence on coelialgia and anxiety of the dyspeptic patient.

The electro-static bath and the ultra violet rays will remedy irritable debility and cerebro-spinal hyperexcitability, which so commonly accompany the solar syndrome (circulatory erethismus, exaggerated reflexes, axillary hyperhydrosis).

We utilized formerly in our treatments, the continuous currents and the faradization of the epigastrium. The progress realized in our apparatus must not let us forget or misestimate those ancient methods of proved efficiency against pain and restorers of the compromised trophicity in gastro-neuritis.

Giddiness is often due to extra systoles (brought on by aerophagy) in overworked patients and those with emotional and obsessional disturbances.

As the static baths represent an excellent process of defense against the irritative solar spine and the post-prandial attacks, they are preferable to belladonna and bromides, those well known classic antispasmodics. Methodical and continuous mechanotherapeutic treatment will secure gastric depletion and regulate the gastroduodenal transit, while alleviating meteorism. Finally in rebellious attacks, there should be no hesitation in having recourse to the Roentgen rays. Not only have they a sedative power on the nervous tissue, but they help to increase gastric leucopedesis, which plays in every dyspepsia an inhibitory and anti-toxic role, remarkably evidenced by Ch. Richet.

By radiotherapy, the chemical operations of digestion become normal and excessive gastric motility (generative of painful spastic reflexes) is restrained. The good effects obtained will be consolidated by means of the electro-thermotherapeutic treatment: radiant heat and light, actino-therapy, and phototherapy.

The solar attack, with painful epigastric palpitation, agonizing hyperesthesia, general fatigue post-prandial somnolence occurs frequently in neurasthenic and ptosed patients. Enriquez's gastric hypertony, Glenard's micro-gastria, Leven's gastric chorea (with or without pyloric incontinency), these affections diagnosed only since the discovery of the Roentgen rays are observed to create hypervagotonic conditions, closely allied by their symptoms to the solar crisis. Whatever may be the case, well managed physical therapy will overcome the trouble. The pain disappears rapidly and the abdomen ceases to be hard and retracted. The epigastrium gradually recovers its suppleness, while at the same time the symptoms of Moutier's "vascular coelialgia," aortic and splenic palpitations are amended, as well as dizziness, aerophagy, etc.

#### CONCLUSIONS

It is by the help of their elective action on the nervous system, the great regulator of the organism, that the physical therapic agents can be utilized with the greatest success in the treatment of various gastropathies. Physical therapy is the heroic remedy of every digestive insufficiency, neuro-motor dyspepsia, atony, ectasy, ulceration and neoplasma. It is applicable not only to cases where exist pain, vomiting, but also to cases where exist defective chemical operations of the organ, the secretory acts of which obey the nervarchic command.

The pyloric syndrome either due to a stenosis or to a simple nervous spasm hindering the duodenal transit appears to be, in every case, suitable for physical therapeutic measures. In case of a pyloric neoplasm more importance will be given to radiotherapeutic seances. In case

of a simple ulcer, our preferences will be for high frequency effluves, stimulating radiotherapy, diathermy ultra violet rays and a special alimentation associated with an appropriate medicamental therapy.

Physical therapeutics should be applied, in every case, before having recourse to surgical interventions. The results, immediate or ulterior, of the physical therapy are generally favorable, especially in case of pain, spasmophilia, ulcerous gastritis, hyperacidity. It may also play the principal role in the re-education of the physiological function of the pylorus.

The solar syndrome, celiac repercussion of a generally old dyspeptic state, is happily influenced by physical therapy methods in cases where hygiene, diet and pharmacopoeia prove to be notoriously inefficient. Radiotherapy and diathermy, both analgesic and spasmophobe, are moreover anti-zymotic and anti-acid. Their judicious applications equilibrate, at the same time, the motility and chemism of the stomach, overcome the angina like erethism and aortalgy.

According to clinical indications it will be necessary to "ring the changes," using separately or combined the various agents: phototherapy, ultra violet rays, vibrotherapy, hydro electric baths, continuous and faradic currents, much as the physician combines different drugs in a prescription. All these precious dynamogenous agents, which exert a stimulating and sedative action on the plexus, stimulate leucopoesis and are thus antitoxic. By their means, we struggle against every irritative process, and at the same time, we restore the glandular functions, the cellular integrity and the organic eutrophy.



## RADIATION THERAPY AT BELLEVUE HOSPITAL\*

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### PREFATORY NOTE

Since its inception a few years ago, the radiation therapy service at Bellevue hospital has developed into a complete integral department with equipment that is adequate and modern. Treatment is given both by x ray and radium to approximately one thousand cases per year.

Bellevue Hospital is the largest municipal hospital in the East, and is utilized as a teaching center by the three great medical colleges located in New York City, and as a post-graduate clinic by the medical profession generally. In this work radiation therapy plays an important part.

From time to time, I have been asked to describe and explain the methods used at Bellevue in the treatment by radiation of various malignant and benign conditions. Frequently, too, I have demonstrated cases so treated. Since these methods have not hitherto been published comprehensively, and there is no similar work extant in this field, I venture to offer the following brief outline for the practical study of radiation therapy in general, and as descriptive of the methods in use at Bellevue.

Radiation is only a comparatively recent procedure in medicine, and therefore it will not be amiss to give a brief historical resume of the subject itself.

Some thirty years ago, while conducting researches in electrical discharges in air and gas in his laboratory at the University of Wurtemberg in Germany, Professor Conrad Roentgen became particularly interested in the phenomena of fluorescence. He had by chance placed a

glowing Crookes tube on a book lying on his desk and containing a metal book mark. The book was resting on a photographic plate holder with plates which he had put there in preparation for an excursion to be taken that day. Subsequently, when he developed the plates, one of them, to his complete mystification, plainly showed the book mark. Accordingly he reconstructed the circumstances, and came upon the discovery that the glowing Crookes tube emitted a certain energy capable of penetrating opaque substances and acting upon a sensitized plate. This discovery he announced to the world in December, 1895, calling the new energy "X Ray."

Since that time there have been very many marked advances in the development of the x ray and its application in medicine, and, with this development in its production and utilization, have grown also the art and science of radiation therapy.

Almost concurrently with Roentgen, Becquerel, in France, devoted himself to the study of radio activity. He worked with uranium, which he activated with sunlight, and believed the subsequently emitted rays were due to phosphorescence. One rainy day when there was no sunlight for his work, he placed the unactivated uranium in a drawer in which there was a photographic plate. When he later developed the plate, it showed effects of the transmitted rays from uranium.

At about this time, too, Pierre Curie in a Paris laboratory was working on the subject of color photography. To this laboratory there came one day a young woman engaged in the study of some problems, among them Bec-

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querel's radio-activity. In 1895 these two workers were married and as Mr. and Mrs. Curie they joined forces in studying radio-activity of various substances. A source of a large, cheap supply of uranium was found in the pitch-blende mines of Austria, and there they set up their meagre laboratory. In December, 1898, they announced to the world the finding of radium, that radio-active substance destined, like x rays, to advance tremendously the therapy of benign and malignant lesions.

My treatment of the subject will be divided into three parts, as follows:

1. Radiation Therapy at Bellevue Hospital—Its Plan and Scope.
2. Methods of Treatment in Use at Bellevue Hospital.
3. Indication Table Showing Methods of Treatment: Outline Showing What We Do or Do Not Treat with Radiation.
4. Practical Physics of Radiation: By Carl E. Braestrup, Radiation Physicist, Bellevue Hospital.

#### PLAN AND SCOPE

Patients requiring therapy are received by the department as:

- (A) Coming from—
  1. The hospital.
  2. The out-patient department.
  3. Elsewhere.
- (B) Coming with—
  1. Radiation card from the hospital.
  2. Note from the doctor.
  3. No note: No card.

If the patient is hospitalized, special radiation card is filled out showing:

- (a) Date. (b) Name of Patient. (c) Age. Ward. (d) Clinical Diagnosis. (e) Resume of salient points of history. (f) Type of treatment suggested. (g) Signature of medical officer.

If the patient comes from the out-patient department or elsewhere, this same type of card is used, and upon approval by the superintendent treatment is given.

(C) A concise history of the case is taken on the patient's first visit to the radiation department. This is obtained:

- (a) Directly from the patient or companion.
- (b) From ward history chart.
- (c) From outside sources, e. g. notes (1) other doctors. (2) Other hospitals.

(D) Examination of patients:

1. Physical.
2. Radiographic. (a) For particular lesion. (b) General or specific metastasis.
3. Special examination: (a) Biopsy is done in all cases where possible, with patients' consent. (b) Blood counts: 1. Ward doctor. 2. Outside laboratory. (c) Urine examination. (d) Photography: Where possible all cases are photographed, and the special lesion specifically noted thereon. (Follow-up photographs are taken from time to time to show the result of treatment and reaction of lesion.)

(E) Decision.

1. To treat as: (a) ambulatory case. (b) hospital case.
2. Not to give treatment.
3. To refer elsewhere.

If the patient is to be treated as an ambulatory case, he is given an appointment card on which the date and time for his return to the clinic for treatment is noted. This card also contains information for the patient regarding personal care of himself in general, and of the lesion being treated, notice regarding change of address, and a request to notify the clinic if he cannot attend for the appointed treatment.

In the case of a hospitalized patient note is made on the patient's chart of the radiation doctor's decision, whether or not biopsy is taken, the type of treatment to be given, special instructions for the care of the patient while undergoing treatment, and the date of return for treatments.

#### PLAN OF TREATMENT

1. This depends on whether it will be: (a) Palliative. (b) Curative. (c) For ambulatory patient. (d) For hospitalized patient.

2. Determined by (a) Type of lesion. (b) Extent of lesion. (c) Metastasis.

3. Whether patient is to be treated with: (a) X ray therapy. (b) Radium.

Each case is discussed from all clinical angles and conditioned on the classification of the patient as above, a concise plan of treatment is worked out. As the course of treatment progresses, changes in the patient's condition are noted, and when necessary, changes in treatment are made.

The patient is informed of the type of treatment planned and his co-operation requested. His schedule of treatments is arranged for and carried out as closely as possible.

4. Course.

5. Follow-up: All patients are requested to return for examination and observation at least once every three months, and are sent for at that time if they fail to report.

#### METHODS OF TREATMENT IN USE AT BELLEVUE HOSPITAL

(A) Treatment: General considerations for radiation treatment.

After examination localization of the lesion and diagnosis have been made, the type of treatment, whether radium or x ray, is decided upon. Certain conditions react to both types, some to

one, and others to a combination of both. A small, readily localized exposed lesion may be treated with radium in plaque or puncture. Large diffuse lesions, multiple metastatic and deep inaccessible lesions are best treated with x rays. The more embryonal in type the lesion, the more radio-sensitive it is. In general we may say that in our experience, squamous cell lesions react best to radium therapy.

The reaction is direct on the lesion and indirectly on the body as a whole. Therefore, general treatment of the patient to build up his body resistance is carried on as well as the specific treatment of the local lesion.

Two forms of x ray therapy are used, the high voltage and the moderate low voltage. The factors for each are 180-200 KV., 4 Ma., 0.5 copper and 1 Al., for the former, and 70-90 KV., 5 Ma., 0 copper, 4 Al. filtration for the latter. The low voltage is used for superficial therapy only.

(B) Specialized Therapy: Benign skin conditions react quite well to low voltage x rays. If the lesion is quite superficial, unfiltered divided doses, spaced one week apart are used. More indurated chronic skin conditions require a small amount of filtration, 1-2 mm. aluminum. Keratotic lesions, corns and warts are treated with double doses of unfiltered x rays, according to the Pirie method.

In all skin cases care must be used in repeating the doses as burns or teleangiectatic scars may result from doses too large or too often repeated. The factors used are 6-8 inch spark gap, 5 to 8 Ma., 9 to 12 inch target distance.

Eczema—Is treated with 1 mm. aluminum filter at 12 inch target distance for three doses, 30 per cent each, spaced 7 to 10 days apart.

Psoriasis—If not indurated, 1 mm. aluminum filter, at 12 inch target distance, 25 per cent

dose per week, per area until the lesion is cleaned up. If indurated 2 MM, aluminum filter is used.

Acne—25 per cent dose per week with 1 mm. aluminum filter over the affected area, with 12 inch target distance.

Pruritis Anis—1 to 2 mm. aluminum, 25 per cent dose for four doses, repeated 7 to 10 days apart.

Hemangioma—In this condition radium has a selective action, better than x ray. Small lesions can be treated with plaque 1 Mc. per square centimeter. In large vascular lesions, radium puncture with steel needles, or 0.2 mm. platinum filtered needles containing radon is used. The dose varies with the size of the lesion, about 1 to 1½Mc. per cubic centimeter. The needles are left in place 5 to 10 days, according to the dosage required.

The rodent ulcer type epithelioma is treated with x rays or radium. Moderate or high voltage x rays using filtration of 5 to 10 mm. aluminum, or 0.5 mm. copper if the deeper rays are required. The dosage is 25 per cent treatment, repeated for four doses, 3 to 5 days apart. Wax molds with radium giving 1 Mc. per square centimeter dose filtered with 0.5 mm. platinum, at 7 mm. distance, applied over the lesion are very satisfactory, and give excellent results. The starting initial dose should be small and left in place for a number of days, as required for the pre-determined total dosage. Increased distance by increasing the thickness of the wax molds is used when the lesion is quite indurated.

Naevi—Are best left alone or eradicated with endothermy, the resultant lesion treated with radium puncture or deep x ray. If they prove histologically sarcomatous a generalized treatment with high voltage x rays must be instituted immediately.

Inflammatory Conditions—In general x rays stimulate hyperemia, and leucocytosis, and therefore may be used in inflammatory conditions. The dosage is mild, 15 to 25 per cent

with low voltage, and filtered with 3 to 4 mm. aluminum, skin distance of 23 to 30 centimeters. Treatment is repeated every 5 to 7 days. Treated in this manner are:

1. Osteomyelitis—Directly on the lesion and on the sinuses. These latter heal rapidly with this treatment.

2. Salpingitis—10 per cent dosage on the right and left pelvic areas anteriorly, repeated in 10 days.

3. Tonsillitis—In acute stages radiation is contra-indicated. Chronic conditions with hypertrophied mass are treated with high voltage, 30 centimeter target distance, with filtration of 0.5 mm. copper. Radiation is directed upward and backward at the angle of the jaw from both sides, 25 per cent dose per treatment at five days interval for four treatments each side.

Carbuncles—25 per cent dose low voltage, 4mm. aluminum filter, repeated 4 to 7 days and if spontaneous rupture does not occur are incised and drained surgically.

5. Tuberculosis—In general x rays react on the surrounding tissues stimulating fibrous tissue changes which occludes the vascular supply to the lesion and causes degeneration and formation of scar tissue with absorption or formation of abscess. If the abscess is not absorbed surgical evacuation is proceeded with.

6. Tuberculous Adenitis—When the glands are hard and massive, 25 per cent dose of low voltage x rays, 23 to 30 centimeter distance with 3 mm. aluminum filter once per week for four doses is given. Repeated after an interval of six weeks if necessary. If glands break down and pus formation occurs this is evacuated before the second treatment. Tuberculous sinuses are treated in like manner. Long standing conditions are treated with high voltage, 0.5 copper filtration, once per week for four doses of 25 per cent each.

7. Tuberculous Peritonitis—If ascitis is present the peritoneal cavity is first drained and the abdomen then radiated. Both low voltage with aluminum filtration and high voltage x rays with copper have given good results. The whole anterior abdomen is given 25 per cent dosage once per week alternately with radiation over the posterior abdomen once per week, the target distance is 30 to 50 centimeters.

8. Brain Tumors—Following localization by operation or clinical procedure radiation is given by high voltage x rays. The rays are so directed as to cross fire through the lesion from four to six fields. The portals of entry are small, 6x8 centimeters, and the distance 30 centimeters. Each area is treated each day, or every second day with 15 to 25 per cent doses until a full dose is given each area. At times the patient may react severely to the dosage and the interval between treatments may be lengthened.

9. Pituitary Tumor—Preliminary radiographs of the skull are taken to localize lesion if possible. Treatment is by cross-firing with high voltage x rays from both sides of the skull and from the center of the forehead. The center field is directly over the nasal area of the forehead. The rays are directed downward and inward towards the sella turcica. A fourth field might be used too, through the occipital bone directed towards the sella. The portal of entry is small; we use a 5 centimeter diameter glass localizer, distance 30 to 50 centimeters, 15 per cent dosage is given over each area at each treatment daily or every second day until the total dosage of 100 per cent is given over each area.

Sarcoma of the Orbit—This is cross-fired from top and bottom and both sides of the orbit and from the base of the skull. The frontal and suborbital fields are small. The center temporal field is 6x8 centimeters. Radiation may be applied directly to the eye ball too, as the eye is useless, at times already removed by operation when the patient comes for radia-

tion. High voltage x rays with heavy filtration 0.5 to 1 mm. copper are used. Dosage is 25 per cent per area every day for 4 to 6 doses, repeated again in 4 to 6 weeks when necessary.

11. Thyroid—The large glandular hypertrophied thyroid and the toxic hyperthyroid cases react well to radiation. Either radium or x rays give good results. Radium in the form of plaques 50 miligrams per side for 10 to 24 hours repeated fortnightly for 2 to 3 doses will show results. With x rays 25 per cent dose filtered with 0.5 copper and 1 aluminum on both lobes repeated once a week for four weeks usually brings relief. Generalized treatment with iodine tonics, etc., may be carried out at the same time. Malignant thyroid tumors are treated with radium needle puncture when small or palliatively, when large with high voltage heavily filtered x rays in small daily doses, at a distance of 30 to 50 centimeters, cross-firing both sides of neck and from a posterior neck field. Usually 15 per cent erythema dose is given on each area, each day for 6 or 7 days. Tracheotomy should be done before radiation treatment is commenced to avoid fatal edema of the larynx.

#### TONSIL

Tonsil: (a) Benign. (b) Malignant.

Benign—Where possible and not contra-indicated by general conditions, hypertrophied tonsils should be surgically removed. When surgery is contra-indicated we treat with deep x rays directed over the angle of the jaw centered on the tonsil  $\frac{1}{4}$  dose per treatment on each side is given once per week for four weeks.

Malignant conditions of the tonsil are treated with radium and x rays. Biopsy is done in all cases. Radium puncture in the lesion, including the pillars. This is done with filtered needles or seeds. When the lesion is quite extensive, deep x rays over the neck glandular area is given first before radium treatment is done.

Where possible, block dissection of neck glands precedes the radiation. The dosage varies, 1 to 2 millicuries of radon per cubic centimeter are used. X rays are given in divided doses, 25 per cent at a time on both sides daily for 4 or 5 doses. Tracheotomy may have to be done preliminary to treatment to prevent suffocation from radiation edema. Mouth disinfection is carried out throughout the treatment till healing takes place. Transitional cell types are treated by external radiation only.

**Cancer of the Lip**—Where localized and small, surgical removal may be done with prophylactic post-operative x ray treatment. If ulcerated and with glandular involvement, the draining lymphatic area is first treated with highly filtered high voltage x rays and then the local lesion with radium puncture, with platinum needles, or with local application of radon on specially prepared wax molds. Puncture 1 Mc. per cubic centimeter. Mold 2 Mc. per cubic centimeter.

#### CANCER OF THE TONGUE

Treatment depends on the condition of the local lesion. Where the lesion is situated, varying accordingly if the lesion is situated in the lateral, posterior, anterior or under part of the tongue. The presence or absence of metastatic nodes in the neck, and whether the case is pre or post-operative influences the plan of treatment. A biopsy is done in all cases and the patient is given disinfectant treatment with mouth washes, and painting of the local lesion with 2 per cent methylene blue solution. Bad teeth and those cutting into the tongue are first removed. Extraction following radiation may cause bone necrosis. The neck gland area is radiated with deep x rays daily, in 25 per cent doses on alternate sides until a full or somewhat more than an erythema dose is given. Surgical block dissection of the neck glands may follow two or three weeks after the x ray treatment. If no operation is done radium therapy of the local lesion is immediately proceeded with.

If the lesion is readily accessible, needle puncture is done with platinum filtered needles of 0.4 mm. platinum wall thickness, 27 mm. to 25 mm. long are used, each containing 2 mg. radium element or 2 to 3 millicuries emanation. These are inserted around the lesion so as to cross-fire through, and are sutured in place. They are left in place from 4 to 7 days, the dosage given being 1 to 1½ millicuries per cubic centimeter. The mouth is thoroughly cleansed with bland solution many times per day. The operation is done under local anaesthesia. If the lesion is quite posterior, gold or platinum filtered seeds are implanted in about the lesion, each seed 1 to 1½ millicuries, the gold are permanently left in place. Seldom is the treatment repeated; later x ray therapy may be applied again to the metastatic neck glands. Such glands which do not react to x rays are treated with radium puncture or with radium pack.

**Cancer of the Mouth**—All loose and decayed teeth are removed and mouth disinfection is done before radiation. If the lesion is small, radium puncture is done locally. In large lesions radium tubes are placed in the lesion directly or in wax molds, 1 to 2 millicuries per cubic centimeter is given. Filtration is equivalent to 1 mm. platinum. The glandular metastases are first treated with highly filtered x rays. If the lesion is extensive palliative treatment only is given with deep x rays.

**Cancer of the Breast**—Radiation technique in this condition is not yet perfected. Often the question of pre-operative treatment is difficult to decide. If there is no supraclavicular metastasis pre-operative x ray treatment is very valuable. Pre-operative treatment must be arranged so that there is a three weeks interval between the end of the x ray treatment and the operation. Where there is marked generalized involvement with ulceration of the local breast condition, and operation is contra-indicated radiation from the palliative stand-point is certainly indicated. Post-operative radiation should be carried out just as soon as possible after the operative



wound is healed, and for this x ray treatment is the best method of choice, except in small local lesions where radium puncture may be used. The treatment plan varies with the intensity and situation of the lesion—whether the lesion is local in the breast tissue or with or without appreciable metastasis. The metastasis may be either local on the chest wall, involving the lung or glands of the neck, axilla and the other breast and the bony skeleton.

In treating a localized breast condition it is advisable to treat prophylactically, the axillary and supraclavicular areas, even though no palpable nodules are present. Cross-firing x rays may be used on the breast lesion proper, and direct raying on the axillary and supraclavicular areas. High voltage x rays in 25 per cent doses filtered through copper in one or two day intervals is given for four doses on each area. If the local lesion is complicated with metastasis, additional cross-fire dosage is given on these areas, too. When possible, direct raying through the lungs is to be avoided, tangential radiation from the sides is preferable. The lateral radiation may be given through the arm. In recurrent metastatic conditions, the affected area is treated directly. Local skin metastasis with short distance heavily filtered x rays at two-day intervals, 25 per cent dose each time. Axillary and supraclavicular areas are given 25 per cent daily with 30 to 40 centimeters distance until 4 or 5 doses are given. They may be cross-fired from back and front, care being taken against burns. If the second breast is involved this is treated in like manner.

Bony skeleton metastasis react well to radiation. If the lesion is in the spine a supporting corset is advisable to protect the damaged area. Treatment is given in 25 per cent doses over the affected bony areas every second day for 4 or 5 doses.

Lung metastasis are treated by directly cross-firing through the lung tissue. If effusive

pleurisy is present the pleura is first tapped and drained and then the lung radiated. Here longer intervals between doses, 5 to 7 days, is necessary as the lung absorbs radiation rapidly.

**Cancer of the Esophagus**—A preliminary gastrostomy is done for feeding purposes and to prevent further irritation of the esophagus mucosa. High voltage x rays are given anteriorly and posteriorly over the area of the lesion. A full erythema dose is given each area and treatments are given daily, alternately over each area in 25 per cent doses. Immediately following the x ray treatment, radium application is done with the aid of an esophagoscope, platinum filtered removable seeds containing 2 to 3 millicuries of radon are implanted directly in the lesion. The number of seeds varies with the extent of the lesion, usually six to ten seeds are used. These are removed via the mouth 5 to 7 days later. No feeding by mouth is done for one to two weeks later, then fluid diet is started and later soft and solid food may be taken.

**Carcinoma of the Stomach**—In inoperable cases, palliative radiation with deep x rays applied anteriorly and posteriorly in small doses, highly filtered frequently repeated is given. A jejunostomy for feeding aids the treatment, and relieves a good deal of the distress. If operation is possible the lesion may be exposed to direct x ray radiation through the operative wound. Highly filtered deep therapy is used. Radium in the form of filtered seeds may also be applied to the local exposed lesion, and withdrawn after the applied dosage is given.

**Cancer of the Pancreas**—Treatment here is palliative only. High voltage x rays anteriorly and posteriorly over the epigastric areas are given in 25 per cent doses daily or every second day alternately, front and back for four or five doses. Cross-firing from right and left epigastrium areas may be done.

**Carcinoma of the Gall Bladder**—Palliative x ray therapy is done. The radiation is directed



over the affected area anteriorly and posteriorly. Treatment is given in divided doses every one or two days until a full erythema dose is given.

**Malignancy of the Colon—**Pre-operative x ray, then operative removal when possible, followed by post-operative x ray therapy. If inoperable, x ray palliation may be given.

**Carcinoma of the Rectum—**Treatment depends on the condition of the patient and the lesion. Treatment is either curative or palliative. A preliminary building up of the patient's general condition precedes all treatment. In all cases a colostomy must be done. This may be preceded by x ray radiation over the anterior and posterior pelvis, in this way radiating the lymphatic drainage areas. If obstruction is marked, immediate colostomy is done, then radiation. Daily douching of the colostomy wound, and lavage of the rectum is essential during the course of treatment. Following the colostomy and radiation, radium in seeds or needles is implanted in the rectal mass. One month after radiation, if the condition warrants, complete resection of the rectal lesion may be done. Where only palliation is possible, x ray radiation of the pelvis anteriorly and posteriorly, two fields each with an additional field over the perineum may be given, in divided doses at weekly or semi-weekly intervals. If a complete rectal dissection is done at the first operation the radiation of the pelvis is carried out as if the malignancy is still present. High voltage x rays are used for the x ray treatment and large portals of entry are used in order to include all the lymphatic glandular areas.

**Benign Hypertrophy of the Prostate—**In this condition x ray is very helpful. If there is marked retention, a permanent catheter with rest in bed is ordered during the treatment. Treatment is deep x ray therapy, with copper filtration, 30 centimeters distance over five portals, two anteriorly and two posteriorly, and one over the perineum, alternately every three or

four days, giving the anterior first, then the posterior, then the perineum, etc., 25 per cent doses on each area per treatment for four treatments, to be repeated after an interval of four weeks if necessary. The application is so directed as to cross-fire through the prostate. An alternate method is one area over the pubis, and one perineal area, 25 per cent dose for four times, alternate areas. This may give results in mild cases. In malignant cases directly following the x ray treatment through the pelvis, radium implantation by seeds, needles or tubes containing radon is done. The radium puncture is done directly through the perineum or following operative exposure of the gland.

**Carcinoma of the Penis—**The inguinal areas are first treated with deep x ray therapy. The local lesion is treated with radium pack or radium puncture with platinum needles containing radon.

**Carcinoma of the Testicle—**Operation where possible, followed by x ray treatment post-operatively over the scrotum, inguinal and pelvic glandular areas.

**Uterus—**The functional disturbances of the uterus are connected with ovarian disfunctions and are relieved usually with treatments on the ovary. Tumors of the uterus may be malignant or benign. Malignant: Surgery is indicated for malignancy of the fundus unless there are general contra-indications. If surgery is impossible or contra-indicated, deep x rays directed on the uterus and pelvis are used. Radium may be used in the uterine canal in conjunction with x rays. Benign tumors of the uterus are usually of the myomatous fibroid type. The cystic tumors are treated surgically. Of the three types of fibroids, intramural, submucous and polypoid, the intramural is the only type for which radiation is indicated. Very large tumor masses are best treated surgically unless operation is contra-indicated.

Fibroids can be treated with either radium or x rays. Radium treatment requires less time, but acts mostly locally over a small area. It is contra-indicated when adnexal infection or inflammation is present, requires surgical procedure and repose in bed. In virgins, surgical procedure may be objectionable. X rays, on the other hand, are more general, work slower, affect the patient less, requires no staying in bed, and the patient can carry on her normal duties. If radium is used, 25 to 50 miligrams for ten to twenty-four hours is placed in the uterine canal after dilation. Radium pack over the abdomen, over the ovarian areas and the tumor mass, may also be used. This treatment may be repeated in a month if necessary. Depending on the size of the patient, the size of the fibroid, the age of the patient, and the amount of distress due to the lesion, a plan of radiation by x rays is worked out. A very thin person with a small tumor may be treated with one portal, over the anterior pelvis, and one over the posterior pelvis, alternately twice per week for four weeks, 25 per cent dose each time. If the patient is stout and the mass large, four areas are used, two anterior and two posterior pelvis. The rays are directed downward and inward so as to include the uterine mass. Usually the portal size is 9x12 centimeters and the distance 30 to 50 centimeters, and the filtration 0.5 mm. copper. Treatment is given once per week using alternately two areas either front or back at one time, for eight weeks. Often the result is accomplished sooner by giving treatment twice per week, depending on the thickness of the patient and the size of the lesion. Sometimes an additional super-pubic field may be given. Another method is to use one large supra-pubic field and two posterior, right and left sacral fields directed through the uterus.

#### FUNCTIONAL DISTURBANCES OF THE FEMALE

Ovary—X ray treatment is of value in menstrual disturbances when no pathology exists. Ovarion disfunction causing dysmenorrhea,

amenorrhea and oligomenorrhea can well be controlled by x rays. Stimulation and partial or complete castration can be accomplished. For stimulation of menstruation, 10 to 12 per cent dose on the ovaries is given. The method is 25 per cent skin dose of deep x ray with 0.5 mm. copper filter on the anterior pelvis, one week later 30 per cent posteriorly, and one week later 10 per cent anteriorly again. By giving two or three treatments on the anterior and posterior pelvis of  $\frac{1}{4}$  doses, either high or moderate voltage, dysmenorrhea can be relieved and menstrual function will proceed normally.

Complete or partial castration may be needed for oligomenorrhea. One-quarter doses twice per week alternately, anteriorly and posteriorly, for four doses, each, usually gives the necessary relief. Sometimes in addition,  $\frac{1}{4}$  dose over the spleen helps refractory cases. If the patient is near the menopause age, the cessation of menstruation may be permanent; if the patient is young it will probably be temporary, and the menstruation when returning will most likely be normal. If with castration the patient has marked menopausal reaction such as headaches, flushings and discomfort, a small 10 per cent dose over both sides of the head directed through the pituitary will in most cases relieve these symptoms.

Benign ovarian tumors are treated surgically.

Malignant ovarian tumors should be radiated directly on the tumor, plus radiation on the pelvis, then treated surgically, and post-operatively re-radiated. Deep x ray therapy is used here, given in daily fractional doses.

Carcinoma of the Cervix—Following examination and biopsy the patient is prepared for treatment. The constipation which usually is present is treated with mineral oil and milk of magnesia or enemas. Thorough douching is given once or twice daily with 2 per cent glucose,

salt, or boric acid solution. Radiation is done with high voltage x rays, anteriorly and posteriorly, over the right and left pelvis alternately. It is given in 25 per cent doses with copper filtration at 30 centimeters distance, and over a 9x12 field, which takes in the inguinal and pelvic glands and ovaries. In large persons 40 centimeters distance, and a 10x15 field may be used. The x ray treatment is given every day until the total dosage is given, and douching is kept up daily during the radiation period. The diet is light with forced fluids, especially fruit juices. Immediately following the application of the x rays, radium treatment is given. The type of radium application varies somewhat with the local condition of the lesion, the amount of parametrial involvement and the histology of the growth. If the lesion is a bulging cauliflower mass, this may first be resected with the endothermic knife, and then the radium applied. The radium application is with the colpostat, a special three cork rubber applicator for the vagina; two of these corks are attached to a spring which keeps them in place in the fornices about the cervix, and one central free cork is placed against the cervix. These corks contain the radium. In the uterine canal a rubber sound containing the radium tubes, is inserted. The dosage varies according to the histology. Basal cell epithelioma requires a small dosage, 4,000 millicurie hours being sufficient, divided equally in the uterus and vagina. If the lesion is squamous cell carcinoma, 6,000 to 8,000 millicuries are used, two-thirds in the vagina and one-third in the uterus. The radium in the vagina is placed so that the largest amount of radium is applied to the area mostly involved. If the parametrium is involved, most of the radiation is directed there. The duration of the treatment varies with the initial radium used.

If radium element is used, the time is shortened; it requires two-fifths more emanation to start with, than radium element to get the dosage and about seven days to four days, respectively. The filtration in the uterus is 1 mm. platinum

or its equivalent. A thin layer of 4/100 AL is wrapped around the platinum to take care of the secondary radiation. For insertion of the radium applicator the patient is prepared as for operation. The genitals are shaved, the bladder drained, and an enema given. Before treatment seven minims Magendie is given hypodermically.

The patient is put in the Trendelenburg position, draped properly, a large Graves speculum is put in place and the vagina thoroughly douched. The cervical canal is located and dilated with long straight graded sounds, usually up to 26 French. No anaesthesia is needed and if the procedure is slowly and carefully done the patient experiences little pain. The rubber sound is then placed in the dilated uterus, and the cork applicator is placed in the vagina. Iodoform packing is placed in and around the applicator for the protection of the bladder and the rectum. The vagina is packed tightly to prevent the extrusion of the applicator. The patient is put to bed and kept there until the course of treatment is finished. Catheterization every eight hours is done if necessary, enemas being given if the bowels do not move normally.

The applicator is removed daily, or every second day, the vagina thoroughly douched, the applicator replaced, and the vagina again packed. The patient is kept on forced fluid diet, such as milk and fruit juices. After finishing the radium treatment, the patient is allowed up and about for two days, douched daily and then sent home with instructions to douche two or three times daily with salt water solution. She returns to the clinic once per week for one month, then twice per month and later after several months, for observation. A week after the radiation, the vagina and cervix are usually covered with a greyish membrane, and there is quite some discharge. Patient is instructed regarding bowel and vaginal hygiene, and advised to build up her strength with nourishing food, fresh air and rest.

In about two months the lesion is all healed locally, and the mucosa looks normal. In some cases the whole vagina is involved, and it is quite impossible to reach the cervix. Here the vaginal lesion is first treated by radium puncture with filtered needles. The dosage is about one millicurie per cubic centimeter of lesion. Later as the vaginal lesion recedes, the cervical lesion proper is treated as already outlined. Sometimes it is quite impossible to locate the cervical canal due to the extent of the lesion. Here the vaginal cervix is treated first, and later the uterine applicator is inserted.

**Carcinoma of the Vulva**—Deep x ray therapy is used over the inguinal areas. Four doses of 25 to 30 per cent each are given, one per day, every day for four days. Then radium puncture is done immediately to the local lesion. If it is very extensive and bulky, a goodly part of the mass may first be removed by endothermy, and then the radium puncture. Dosage 1 to  $1\frac{1}{2}$  millicuries per cubic centimeter is used in platinum filtered needles. The radium needles are left in from four to seven days in order to get the dosage required.

**Hodgkins**—This being a generalized condition, not only the visible swelling complained of, but all areas likely to show involvement are treated. High voltage x rays are used, the size of portal field varying with the size of the area treated. A chest radiograph is always taken for examination of the mediastinal area. In cases limited to visible involvement of one or two areas as neck or axilla, treatment is given twice per week in 25 per cent doses alternately, with one treatment per week over the mediastinum anteriorly and posteriorly until a full dose is given. In more marked cases all the lymphatic and involved areas are treated in three-day intervals. The interval between treatments may have to be prolonged if the patient's reaction is severe. For the mediastinal, splenic areas, 9x12 centimeter fields are used; for the neck and inguinal areas 6x8 centimeter or 9x12 centimeter fields

may be used. The distance is 30 to 40 centimeters, filtration is 0.5 mm. copper and 1 aluminum or 1 mm. zinc.

**Lympho-Sarcoma**—The reaction to x rays is very prompt. High voltage x rays with 1 mm. zinc filtration gives the best results. The lesion is cross-fired from several directions and the dosage is 15 to 25 per cent per area, every one or two days until a full dose on each is given. Where the lungs are involved they are treated with large portals over one lung at a time alternately, anteriorly and posteriorly, usually with 50 centimeter distance.

**Leukemias**—The reaction to x rays is rapid and gratifying. The spleen, the enlarged glandular areas and the long bones are treated. Treatment is usually given on the spleen alternately, anteriorly and posteriorly in 25 per cent doses once a week. Then the glandular areas are treated and later the long bones. With marked glandular involvement the spleen and the involved glandular areas are treated alternately every second day until a full dose is given. Blood counts are taken before each treatment for controlling the response. The course of treatment is not repeated within three or four weeks. High voltage x rays with copper filtration at 30 centimeters distance with a 9x12 centimeter field are used.

**Sarcomas**—Bone sarcomas are treated with high voltage x rays filtered with copper. The area to be treated is built up with bolus bags so as to make the portals of entry more uniform. The dosage is 15 to 25 per cent per treatment, daily or every two days, each area, until the full dose is given. If lung metastasis are present these are treated at the same time.

**Infantile Sarcoma of the abdomen** are treated with deep x rays with 0.5 copper or 1 zinc filtration. The lesion is treated from different areas, one area per day in 15 to 25 per cent doses until the full dose is given. Longer intervals

between doses is required if the reaction is severe following each dose.

**Fibro-Sarcomas**—These are treated with high voltage x rays, with copper filtration directly on the lesion with 25 per cent doses repeated daily for four doses.

**Sarcomatous Tumors**—Are treated with high voltage x rays, with small doses, repeated daily until the full dose is given, cross-firing through the lesion from different areas.

**Actinomycosis**—Lesions and sinuses react well to small repeated doses of high voltage x rays.

#### CONCLUSIONS

As a general rule our method consists of using radiation in small doses over a long period of time. For local or skin lesions, moderate voltage x rays lightly filtered, in fractional doses directly on the lesion. Large and inaccessible lesions, high voltage x rays, heavily filtered in repeated fractional doses, the rays cross-firing through the lesion from multiple portals of entry.

For radium treatment we use radon or radium emanation. Application is made locally in plaques or molds, in puncture with needles or application with special made applicators. Small doses in highly filtered applicators, treatment extending over a long period of time.

#### INDICATIONS FOR RADIATION THERAPY GENERALLY

Small local accesible lesions easily completely removable are treated surgically. If the lesion interferes with body function and an immediate relief is required, surgical is indicative. On the other hand, generalize malignancy, lesion with metastasis, large inoperable lesions sarcomata should be treated with radiation.

In those cases where associated conditions which are contraindications for any surgical in-

terference, radiation is indicated. Where but palliative treatment can be given and as a post-operative prophylaxis radiation therapy is advisable.

#### IN DETAIL

The treatment given at Bellevue Hospital for the following conditions are indicated in the subjoined chart. The mode of treatment varies, somewhat, whether the condition is benign or malignant.

##### 1. Benign conditions—

(A) Treated with low voltage mildly filtered x rays are: Skin lesions, such as,

(a) The exanthemata, acne, exzema, pruritis, psoriasis.

(b) Ringworm of the scalp, ringworm of the fingers.

(c) Keloids.

(d) Keratosis, carbuncles and furuncles.

##### 2. Adenitis—

(a) Inflammatory.

(b) Tubercular.

(c) Inflammatory adnexal conditions.

3. Enlarged thymus in infants.

4. Unresolved pneumonias.

5. Tubercular peritonitis.

6. Whooping cough in children.

7. Osteomyelitis.

8. Tubercular sinuses.

(B) Treated with low voltage x rays without filter, are:

(a) Corns. (b) Warts. (c) Naevi.

(C.) Treated with high voltage heavy filtered x rays are:

1. Leukemias.

2. Hodgkins.

3. Hypertrophied tonsils.

4. Hypertrophic prostate.



5. Functional disturbances of the female genitalia as: (a) amenorrhea, (b) dysamenorrhea, (c) oligomenorrhea.

6. Fibromyoma uteri.

7. Hyperthyroidism.

(D) Treated with radium—

(1) Hemangioma. (2) Benign uterine bleeding. (3) Hyperthyroidism.

2. Malignant conditions: These may be treated with a combination of surgery, radium, and x rays; radium and x rays; or radium, or x rays alone. Localized tumors may be excised, then treated with radiation. Excision may be done surgically with scalpel or endothermy.

In the treatment of malignant conditions high voltage x rays heavily filtered, in repeated small doses over a long period of time are used.

In radium therapy, small doses over a long period of time in heavily filtered applicators are used.

1. Skin: Rodent ulcer, epithelioma, carcinoma, melano sarcoma, are treated with x rays or radium. Hemiangioma are treated with radium.

2. Sarcoma and lympho-sarcoma are treated wherever situated with x rays.

3. Generalized metastasis are treated with x rays.

4. X rays external and radium locally are used in the treatment of malignancies of the accessible lymph nodes, the tonsil, tongue, mouth, the larynx, esophagus, thyroid, rectum, prostate, bladder, penis, cervix uteri, vulva, and vagina.

5. X rays are used in malignancy of the eye, inaccessible larynx lesions, breast, mediastinal tumors, lung tumors, malignancy of the

abdominal organs of the ovary, the testes, and of the bony skeleton.

6. For post operative radiation x rays are used.

7. As palliative treatment only in inoperable hopeless malignancies x rays are indicated, such as:

(E) Malignancy of the—

(a) stomach, (b) pancreas, (c) liver, (d) the small intestine, (e) colon, (f) rectum, (g) retroperitoneal glands.

## PRACTICAL X RAY PHYSICS

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The aim of this article is to give an outline of the physical factors to be considered by the radiation therapist. A thorough knowledge of these aspects of radiation therapy is essential in order to apply x rays most effectively.

X rays like ordinary visible light may be defined as radiant energy or electro-magnetic vibrations. The only difference between the two is that x rays have a much shorter wave length.

Production of X Rays—Wherever fast moving electrons are suddenly stopped x rays are produced. Today, practically all therapy is done using the hot cathode or Coolidge type tube. This type of tube consists of a highly evacuated glass bulb having two electrodes, the cathode and anode, also called the target. The cathode is heated by an auxiliary circuit thereby liberating small negatively charged particles called electrons. By applying a high voltage across the cathode and anode the liberated electrons are pulled toward the anode where their sudden impact produces x rays.

Equipment—From the above it will be seen that to operate the Coolidge tube it is essential to have an apparatus which produces the high tension voltage in addition to the filament current used for heating the cathode. According to the way the high tension is produced the apparatus may be divided into three types: Interrupter type, mechanical rectifier, valve tube rectifier.

The interrupter type machine consists of an induction coil having two windings, the primary and the secondary. The primary winding is connected to a direct current power supply through various controls and an interrupter. Each time the interrupter breaks the primary circuit a high voltage is induced in the secondary winding, the terminals of which are connected to the x ray tube.

The most commonly used type of equipment is the mechanical rectifier. Here alternating current is applied to the primary winding of a transformer which is a device for stepping up the voltage. The secondary winding of the transformer is connected to a rotating switching device called the rectifier. By means of this rectifier the high tension alternating current is changed into pulsating unidirectional current which is applied to the x ray tube.

In the valve tube machine the rectifying switch has been replaced by hot cathode valve tubes. The valve tube, which is constructed somewhat similar to the x ray tube has the same characteristic of only allowing the current to flow through in one direction provided the anode is cool. By using four of the valve tubes and adding condensers of sufficient capacity it is possible to construct a generator which produces high tension direct current.

X Rays—May be classified according to their penetrability or hardness. Rays that have high penetrating power are called hard rays, while soft rays are those of low penetrability.

The relation between the hardness, the voltage across the tube—K.V.—and inches of parallel gap and wave length is shown below:

Type of Rays—	K.V. Peak	Gap In.	Wave Length Angstrom Units
Very soft .....	40	1.5	.310
Soft .....	80	4.36	.155
Medium .....	120	7.81	.103
Hard .....	160	11.1	.077
Very Hard .....	180	14.1	.062

As indicated in above table the penetrability increases with increased voltage across the tube while the harder rays have the shorter wave lengths.

Each bundle of x rays is composed of component x rays of varying wave lengths. This is the case even where a direct current voltage is applied to the tube although the x rays with this type of current are more homogeneous than when produced by pulsating uni-directional current of very peaked wave form. While the minimum wave lengths produced by either type of current would be the same the effective wave length of the tube operating on direct current would be lower.

The relation between the maximum voltage across the tube and minimum wave length is expressed by Hunts law:

$$K.V. = 12.354$$

$$\text{Max. Min. wave length in A.U.}$$

Physical Dosage—The proper dosage depends upon the accurate determination of the quantity and quality of the x ray beam. The quantity or intensity of radiation is proportional to  $MA \times \frac{KV^2}{D^2}$  where MA is the tube current,

KV the voltage across the tube and D the distance to the target. In other words if MA is doubled the intensity is twice as high, if the voltage is doubled the intensity is  $2^2$  or four times as high. If the distance is doubled the intensity will be one quarter. The following

methods are the most common for determining the intensity:

1. Electrical input into tube (indirect method).
2. The selenium cell.
3. Pastilles.
4. Ionization.

**Indirect Method**—Various books give formulas according to which it is possible to determine the intensity of radiation by merely measuring the current and voltage of the x ray tube. This method is very crude and assumes that every x ray tube is alike and the wave form of the voltage across the tube is constant. Unfortunately this is far from being the case and the electrical factors should only be used for duplicating settings on the same machine and tube. The voltage should be measured by a sphere gap in preference to a point gap or the primary voltmeter with its inherent inaccuracy. The sphere gap gives the maximum voltage and therefore indirectly the minimum wave length. The current should be measured by two milliammeters, one of which should preferably be at ground potential to eliminate any error due to electro static forces acting on the meter needle.

**Selenium Cell**—The selenium cell has the property of changing its electrical resistance when exposed to ordinary light or x rays. This is utilized in the Furstenau intensimeter where the change in resistance is measured by means of a galvanometer. The reading of the galvanometer is therefore a function of the intensity. This type of instrument does not give an absolute measurement of the intensity. However, when used by experienced operators the average accuracy obtained may be higher than that gained by the more delicate ionization instruments.

**Pastille Method**—The Pastille method depends upon the property of barium plantino cyanide changing from a greenish color to a

brownish yellow when exposed to x rays. By means of an arbitrary scale it is therefore possible to gauge the intensity.

**Ionization Method**—The most accurate method today, although far from ideal, is the ionization method. When air is radiated it becomes conducting or ionized. If, therefore, two insulated plates are placed in the field of the rays and connected to a suitable voltage the rate at which electricity passes from one plate to another is a measure of the intensity of the beam.

The place where the ionization takes place is called the ionization chamber. Ionization instruments may be divided into two groups pending upon the way the conductivity of the air is measured. The first type measures the rate of discharge of a charged electroscope or electrometer. This method is the one generally used for standardization as the intensity may be measured in absolute units. It has, however, the disadvantage that it takes many seconds to obtain the reading. The other method uses a galvanometer or microammeter giving a steady deflection showing the amount of current passing through the ionization chamber. Here a high voltage battery or rectified alternating current is used for supplying the voltage across the chamber. This method has the advantage that the meter reading is a direct indicator of the intensity.

**Quality**—Due to the different biological effects of hard and soft rays it is, of course, also necessary to determine the penetration of the radiation. We have the following methods:

- Voltage across x ray tube (indirect method).
- Spectrometer.
- Absorption.

**Indirect Method**—By means of Hunts law the minimum wave length or maximum penetration can be easily determined if the voltage across the tube is known. The most accurate

means of measuring the voltage is the sphere gap, although the point gap may be used to advantage at low voltages. Any indirect method does not tell all that is wanted; it merely gives us the maximum penetration.

**Spectrometer**—Just as ordinary light may be broken up into its component parts x rays may be divided up in its component wave lengths by means of any x ray spectrometer. Here the surface of a crystal is used to deflect the x ray beam. As each wave length has a different angle of deflection it is possible to get a photograph of the spectrum. By means of an index furnished by the manufacturer it is then possible to determine the wave lengths of the component beams.

**Absorption Method**—The measurement of quality by absorption is a very logical and practical method. In therapy our interest in penetration is primarily in order to determine the absorption by the human body. The harder the rays are the greater is the thickness of material required to give the same percentage of absorption. Consequently the thickness of—say—aluminum which reduces the intensity of an x ray beam to one half, gives us a definite measure of the effective penetration or wave length of the beam. This thickness of the aluminum is called the Half Value Layer. The relation between the half value layer and the voltage across the tube will vary with each machine due to the different wave form of the voltage across the tube.

**Secondary Radiation**—Whenever x rays pass through matter we have in addition to the primary radiation secondary rays given off by the radiated substance. The most important part of the secondary radiation is that caused by scattering. Scattered rays may be considered primary rays merely deviated in direction. They have the same penetration as the primary rays and their intensity depends upon the density of the substance. The lower the density the greater

is the scattered radiation in proportion to the absorbed radiation.

In addition to the scattered rays we have the characteristic radiation which are rays having wave lengths characteristic for the radiated substance.

**Filtration**—Even with a constant voltage applied to the tube the radiation is far from homogeneous. Inasmuch as hard rays are desired in deep therapy the aim is to eliminate the soft rays which otherwise would be absorbed by and possibly harm the skin of the patient. This is accomplished by means of filtration. By interposing a plate between the tube and the patient the intensity is reduced. The soft rays are absorbed more readily than the hard ones and it is therefore possible by selecting the proper material for filter to get radiation whose effective wave length approaches the shortest wave length. In choosing the proper filter the aim is to use a material where the absorption of soft rays is high compared with the absorption of hard rays. In deep therapy  $\frac{1}{2}$  to 1 mm. Cu plus 1 mm. Al. is generally used. The aluminum filter is placed between the copper filter and the patient. The characteristic radiation of the copper is therefore absorbed by the aluminum.

**Practical Dosage**—So far it has been shown how the dosage depends upon the electrical input into the tube, the filters used, the size of the field, the focal skin distance and the depth in the body.

The amount of radiation that can be given to a deep seated malignancy is limited by the tolerance of the skin. In order to have a common standard of dosage the term Erythema Dose is used. At Bellevue Hospital the Erythema Dose is that quantity of radiation which when applied to the skin under specific conditions produces a reddening in seven days and which in thirty days results in the tanning of the skin. The time (in minutes) required to produce an

Erythema under certain standard conditions is used as a basis for calculating the erythema time under different conditions. The standard working factors used at Bellevue are the following: 200 K.V., 4 M.A., 23 cm. F.S.D.,  $\frac{1}{2}$  Cu., 2 mm. Al and 6x8 cm. field. This dosage is measured physically with an electroscope which has been checked biologically on standardized x ray apparatus.

As the intensity is proportional to the milliamperage the erythema time may be reduced by merely increasing the current in the same proportion. Thus, if the M.A. is raised from 4 to 8 the time will be reduced one-half to give approximately the same dose. To calculate the time necessary for any given distance knowing the time for 23 cm. the following formula is used:

Required distance  $\times$  known time = required time.  
Known distance

Example: The time necessary to produce an erythema under standard conditions (200 K.V., 4 M.A., 23 F.S.D. 6x8 Field  $\frac{1}{2}$  Cu. plus 2 Al) is thirteen minutes. What would be the approximate time if the F.S.D. is changed to 30 cm., all other factors being the same? Substituting in the formula we have  $30/23 \times 13$  equal to 22 minutes.

Let us now consider the case where we want to give maximum dosage say at a depth of 10 cm. with minimum effect on the skin. The penetration should naturally be as high as possible which means that the maximum voltage should be as high as the tube would stand with safety. To cut down the treatment time the milliamperage should be as high as the tube will permit without overheating.

The size of filters should be determined by physical measurements. The right size will be

the one where a further increase in thickness does not show any appreciable improvement in percentage depth dosage. Consequently, a thicker filter will merely cut down the intensity.

The greater the size of field the higher the percentage depth dosage on account of the increased amount of scattering. In order to make the depth dosage high compared with the skin dosage the focal skin distance should be large. As the intensity is reduced at the same time there is, however, a limit beyond which it is impractical to go.

Safety—Every x ray installation should be provided with ample electrical and x ray protection.

The magnitude of the voltage used in deep therapy makes it necessary to see that there is ample of clearance between any high tension and the patient. From the point of view of protection the grounded enclosed metal tube holder is the ideal arrangement. Here the high-tension conductors and terminals of the tube are shielded from the patient, eliminating any possibility of shocks. If an open type tube stand is used an insulated or wooden table should be provided.

The protection against x rays should eliminate any stray radiation to the patient, operator and persons in nearby rooms. Pending upon the protective value of the tube holder the walls, floors and ceilings should be provided with 1/16 inch to  $\frac{1}{4}$  inch lead or equivalent thickness of other protective material.

It is hoped that this paper has given the essentials of radiation physics in a form which will encourage the reader to give more consideration to the physical side of therapy. While the physical measurements of quality and quantity at present are far from ideal they will no doubt be of increasing value in the future.



## A FEW PRACTICAL INDICATIONS FOR ELECTROTHERAPY\*

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At a medical meeting recently, I heard an exceedingly good paper by a physical therapist. During the discussion, a prominent surgeon arose and said that the paper was doubtless quite excellent, but personally he was not rapturously interested in Angstrom units, the comparative merits of d'Arsonval and Tesla coils, the geometrical curves and mechanics of wave and sinusoidal currents, etc., etc.; but, as a surgeon, he was particularly interested in knowing when and where physical therapy might be indicated primarily as well as adjutantly.

First of all, what is physical therapy? I define it to my students as being any modality, treatment or aid to health that is not essentially chemical or surgical in action. I am going to confine myself now to some practical indications for electrotherapy. Owing to Dr. Friel of London, otitis media is being quite successfully treated with zinc ionization. A clear cut diagnosis, however, must first be made. Osseous degeneration, polypi, cholesteatoma, must be initially disposed of; and only when the otitis remains or is existent as a "tympanic sepsis" will the case brilliantly respond to electrotherapy.

In Rollier's clinics one will see hundreds of bone tubercular cases, many of them absolutely riddled with discharging sinuses of various degree and description. If purely tubercular, these cases will heal quite rapidly under the combined influence of alpine sunshine or ultra violet, mountain air, and—expert orthopedic attention. Such natural physical therapy surroundings in a high altitude are also of material benefit even in the large proportion of cases complicated by a mixed infection. Pulmonary tuberculosis, however, does not respond well to

such extremes of heat and cold as are experienced at this Alpine retreat. The milder climate of Davos or Denver is indicated for this distinctly different expression of tuberculosis. This satisfactorily explains why a carbon arc lamp may be more suitable for the treatment of certain conditions than would be the exuberantly popularized quartz mercury arc. The former more nearly approaches the spectrum of natural sunlight, while the latter contains a preponderance of shorter wave lengths, but with less of the infra red. For general metabolism; in rickets; wherever assimilation of available iron, lime and phosphorus is the therapeutic desideratum, the carbon arc will be preferable. When we wish to avail ourselves of an intensive application of ultra violet of shorter wave lengths for more specifically bactericidal effect, the quartz mercury arc will be indicated.

Bronchial asthma is a difficult condition to satisfactorily treat with drugs, but diathermy will almost invariably alleviate and quite often more or less permanently. While there has been some argument to the contrary, I have always found diathermy applied posteriorly and anteriorly to the chest walls to be far superior to anything else in the way of electrotherapy. Such an application of penetratingly sedative heat, not only diminishes respiratory spasm, but additionally stimulates the patient's metabolism and thereby acts as a physiological antidote to this terribly disastrous and agonizing respiratory congestion.

An extremely convenient and logically correct method of applying diathermy—not alone to the chest, but elsewhere—is to use the thin auto-condensation pad as the larger dispersing electrode, with the usual tinfoil of convenient size for the smaller local or more actively thermal electrode.

\*Read at fifth annual meeting, American College of Physical Therapy, Chicago, Oct. 21, 1926.

As asthma is one of the most common manifestations of anaphylaxis, ultra violet—preferably the carbon arc—is exceedingly good adjuvant treatment for its constitutional effect in such cases, especially when occurring in children.

The abdominal surgeon can find frequent use for physical therapy, or at least for the physical therapist. Usually the average operative case is dismissed at the end of possibly two weeks, with the advice to stay quiet for an indefinite period of time before resuming business or social activity again. Naturally, after an abdominal section, the local, contiguous neuro-vascular system is somewhat weakened. This incidental stasis and impairment of function is productive of more or less prolonged convalescence and—quite possibly, chronically sequent local and constitutional debility of function. Even before the wound heals—and certainly as soon as it has securely united—radiation of the entire body is indicated; first with a radiant heat and light lamp of 1000 watts, and this immediately followed with the carbon arc or an air-cooled quartz mercury arc lamp. This tonically acts upon metabolism; and such stimulant light and ultra violet radiations are beneficially indicated in almost any disease, acute or chronic, with the possible exception of diabetes mellitus.

The water cooled ultra violet lamp is always and invaluablely the apparatus of choice for local effect where the infection, ulceration, wound or traumatism can be conveniently exposed to its superficially active bactericidal action. The air-cooled quartz mercury arc is also bactericidal and slightly more penetrant, but is characterized by more heat and must be administered for a longer seance of time; also, it is by no means so conveniently and definitely applicable for small, localized lesions.

Rythmical or contractile currents, such as the wave and sinusoids, are indicated in the

majority of convalescent cases, operative as well as non-operative—when the wound is firmly united—as a physiological stimulus to otherwise impaired peristaltic action.

Abdominal adhesions are quite common—relying upon the patients' complaints, as founded upon their surgeons' advice to be reoperated upon. Naturally the longer such adhesions have existed, the less probability of satisfactorily disposing of same by physical therapy. Nevertheless, diathermy, negative galvanism, and wave or sinusoidal currents, if expertly and persistently applied, will often do wonders in partially absorbing or at least more resiliently impressing these pathological hindrances to normal pelvic function. As prevention is invariably better than later curative attention, the possibility of such post-operative adhesive reminders arising from prolonged or stormy convalescence should induce the surgeon to preventatively prescribe the indicated physical therapy just as soon as his patient's locally operative condition will safely permit. Congestion starts irritation, which latter, the more prolonged, is quite apt to cause scar tissue or adhesions.

While there can be no argument as to the indication for surgery in anal fistula, still, there are certain cases of limited depth and length that can be disposed of by zinc ionization, using a zinc wire threaded through the fistula as the active electrode on the positive pole of a direct current.

Prolonged convalescence from severe fractures or dislocations can be greatly lessened by diathermy and wave or sinusoidal currents. Stasis may be thus overcome, both mechanically and thermally, and a more vigorous vascular and lymphatic circulation be passively achieved with no volitional exertion or stress upon the part of the patient himself; and muscular weakness and atrophy consequently reduced to a minimum.

Despite occasional argument to the contrary, authorities practically agree that though it is difficult to establish an anatomical difference between neuralgia and neuritis, yet clinically they are quite different and have little in common.<sup>2</sup> Neuralgia, when the nerve is superficially accessible, can often be considerably relieved by galvanism; Lewis Jones<sup>3</sup> mentions several instances of otherwise intractable cases that were successfully treated by electrical ionization of sodium salicylate from the negative pole, or of quinine bichloride from the positive pole of a direct current.

Negative galvanism is indicated in the treatment of chronic neurites, if the current can absorptively penetrate to the affected sheath. Galvanism should be followed, in these cases, by wave or sinusoidal currents or—preferably—with the Morton static condenser discharge. In the acute neurites, applications of diathermy, not too prolonged or strenuous; the radiant heat and light lamp for half hour or hour exposures, at a distance of at least 15 inches away; mild erythema doses of ultra violet from the carbon arc or the air cooled quartz mercury arc; the pencil effluve from a static for twenty or thirty minutes, will be found variantly advantageous

according to the degree and localization of the condition.

Wherever heat—superficial or deep; passive contractions of musculature or organs; direct, superficial, or indirect but less superficial bactericidal effects; improved metabolism; may be indicated, some form or other of physical therapy: electrotherapy will be found conveniently and valuably indicated and available.

Physical therapy should not usurp indicated medicine or surgery; neither should these latter usurp indicated physical therapy. Each should contribute its maximum quota to the welfare of all the others; and no solitary member of the triad should be expected to do anything that could possibly be better achieved by some other better indicated method of treatment.

#### BIBLIOGRAPHY

1. Friel, A. R. *Electric Ionization*, 1922.
2. Stevens, A. A. *The Practice of Medicine*, 1926.
3. Jones, H. Lewis. *Medical Electricity*, 1920.

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# EDITORIAL

## ARCHIVES OF PHYSICAL THERAPY, X-RAY, RADIUM

A Journal of Ideas and Ideals.

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### WHAT PRICE PHYSICAL THERAPY

It has been said that "The great law of the Infinite Mind is that the use of a thing determines whether it is good or not." Yet whenever something new is advanced to the medical profession an element of doubt arises in the minds of many. Strong stands are taken against the discovery because it is new. Without any knowledge of its merits or demerits, the cry of

condemnation arises. So it has been with physical therapy. This is not wholly unexpected for the reason that in times past, the history of medicine tells us, this scathing criticism has existed. It took some ten centuries for the first medical treatise to be published because of this fact. Anatomy, physiology and therapeutics were known and accepted centuries before doctors had the audacity to write of these things.

There is an anecdote of a clergyman who had been in the ministry some forty years in a small hamlet which may have a moral along these lines. This divine had lived in this rural district all his life of some sixty years. He was highly respected, and his advice was sought, and his judgement relied on by his many parishoners. By chance, this clergyman had the opportunity to visit one of the great cities of the land. Upon his return, he related many of the interesting sights he had seen. He told them of electric lights, street cars, gigantic buildings, and among other things he told them he had seen ice manufactured in the month of July. All was accepted as true but the ice in July. After the usual servicees on Sunday when he told them of the process of making ice, a congregational meeting was held, and he was literally charged with lying, and dismissed by his congregation. The idea of ice in July, even though he had until this time been the idyl of his flock, the material as well as the spiritual leader in his community, he was crucified because he told them that he had seen ice made in one of the summer's hottest months.

So it has been with physical therapy. The work of the immortals who were equally as loved,

respected and revered in their several communities as was this clergyman, are severely censured by those who seek relief for their ills as well as by their professional confreres who hold them in great esteem. "Impossible!" is the cry. "Preposterous!" say some. "They have gone astray from the fold of organized medicine", say others. Yet for no good reason, with no knowledge of its virtues, these immortals of medicine are trodden down and sunk into oblivion only to be immortalized many years after their passing.

It is the practice of the medical profession to condemn without trial. Let one advance a cure for cancer and see how it is received. A cry of "fake" arises from all sections. Instead of allowing a fair use of the remedy, cases which are hopeless, and with one foot in the grave are sent to him with the words "Cure this one." A potent example is the x ray in malignancies. All other means, inadequate as they are known to be, have been exhausted before the x ray is employed. Then because the percentage of cures is small, and because of the marked advancement of the disease, the x ray as a remedy for malignancy is a complete failure. If, on the other hand, these cases had been subjected to x ray in the early stages they might have been cured. But no—because the x ray will not cure the most desperate cases, it is no good at all.

"There are none so blind as those who will not see," is another adage which might also apply to physical therapy. If one had spoken of automobiles and aeroplanes some fifty years ago, no doubt it would have called for an examination by competent psychiatrist. Yet today the sanity of those who would say "there are no such things" would be questioned. Those who do not want to see physical therapy might be placed along with these. They won't see it even if the most competent, high minded, and ethical of doctors say there is virtue in physical therapy. These doctors are ridiculed, snubbed, and even accused of commercialism by those whose vis-

ion has been obscured by an idiopathic cataract of willful blindness.

It is no wonder that the charlatan and irregular survive. These individuals take up the new discoveries because the public demands something new, but mostly for remunerative reward. Old remedies have proven unsuccessful, so something different must be tried. The boldness of the charlatan will cause him to try anything regardless of its virtue. The ever anxious public is forced to consult these of little medical training. The cry of humanity is, "What can I do to get well?" "I'll not give up." "I will try anything to get well." Sometimes people are not as sick as they think they are, and the charlatan takes advantage of this fact. The individual is benefited by this new treatment. The result is more patients for the irregular. The medical profession often forces the public to seek aid at the hands of the charlatan. Why? Because they will not investigate the new remedies, but sit back on the time-honored dignity of the profession and say it can't be done. Many times it can be done.

After all, the court of last resort in medicine is the clinical result. No matter how this is obtained the result is what counts. If successful results are obtained, it makes no difference whether it is with medicine, surgery or physical therapy. It must be accomplished by one of these methods. It could not be done otherwise. So physical therapy is just as important as medicine or surgery. It has taken its place where it rightfully belongs. Physical therapy is just as old as medicine or surgery, only it has been called by a different name. Physical measures were used long before lotions and decoctions. It was the only means the primeval physicians had. Some comfort was afforded patients, some cures were made, and now-a-days with the light of experience of the ancients coupled with the more recent scientific discoveries, many things are accomplished which could not be done by any other methods.



Another thing which stands in the path of physical therapy is that many physicians are unwilling to trust each other. Instead of investigating, they stand as a stumbling block in the way of medicine. They begin to offer any number of excuses. "It does not sound logical; it is not scientific; it lacks certain specific proof." How could it do otherwise if the remedy is not tried, nor the best opinions respected. Therefore, the public does not get the benefit of many excellent remedies until years have past. The public is several years behind. Why? Because the average physician will not trust the opinion of his confrere.

After all, is medical research and progress worth while? The criticisms, knocks, abuses, and divided friendships which research causes might be considered reasons for its abandonment. Yet on the other hand, the satisfaction of giving patients the benefit of potent remedies is reason enough for research. The glory and satisfaction of cures and duty well performed tops any other reason. The relief of pain, a few years added to the span of life, and the comforting feeling that something real is being done to relieve suffering and combat disease is reward for research. With all its antagonistic criticism and embarrassments, physical therapy has made remarkable strides until it is no longer on the defensive, but stands as a powerful agency for the good of mankind. So, What Price Physical Therapy?

—Frank H. Walke.

#### REPORT ON THE 1926 THESIS CONTEST

The committee selected to review the manuscripts submitted in the contest of last year on some original research problem in the field of physical therapy reported to the chairman of the thesis committee as follows:

"We regret that while several excellent papers were submitted not a single one conforms to the rules outlined in that there is in prac-

tically every case a distinct lack of originality of the problem discussed. This does not necessarily imply that the entrant of the contest was cognizant of this lack of originality, as it frequently happens that scientists present the results of their independent research without a knowledge of existing priority. In view of this situation with the papers submitted to us for review, we cannot conscientiously recommend the distribution of prizes as offered in the contest."

Respectfully,  
The Committee of Judges.

A checkup of this by a second committee yielded a similar report.

It has therefore been decided by the thesis committee to refrain from asking the manufacturers who were so kind as to offer certain pieces of apparatus for prizes to make delivery of these prizes since no prizes will be awarded.

The committee wishes to thank those who made a determined effort in the contest and regrets the necessity of this report. The committee appreciates the cooperation of the manufacturers and dealers.

For the very careful, painstaking and unbiased scrutiny of the manuscripts by the judges, the gratitude of the president and officers of the college is hereby publicly extended.

#### EUROPEAN TOUR AMERICAN COLLEGE OF PHYSICAL THERAPY 1928

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Mindful of the great benefits to be derived from first hand contact with European leaders in our profession, THE AMERICAN COLLEGE

OF PHYSICAL THERAPY invites you to attend a series of lectures to be held at the leading centers of physical therapy abroad. You will note the itinerary has been very carefully planned to give ample time for clinics and lectures as well as an opportunity to visit principal points of interest in the various cities. While enroute on the Atlantic liner a systemized course of lectures will be given on physical therapy by two leading teachers in this special work. There will be demonstrations and personal conferences in all branches of electro-physical therapy.

The steamships used are well known Cunard cabin boats offering every comfort at minimum rates, and only hotels of repute will be used. For those desiring to attend the Radiological Congress at Stockholm in July an extension tour can be arranged at very little additional cost. Ladies are welcome, special provisions having been made for their diversion while the doctors attend the lectures and clinics.

The membership fee is \$937 from New York to New York, which includes all steamboat, railroad and motor car fares, hotel accommodations with table d'hôte meals; all sightseeing, as provided in the itinerary, and all tips to hotel staffs and baggagemen, except in England where tipping en masse is resented. A large suitcase is presented to each member, which will be transported through the trip free of charge.

This is an unusual opportunity for the doctor to combine a pleasure trip with one that will give him a very intensive course in physical therapy, together with close observation of the work in this specialty that is being carried on by the pioneers of Europe. The instruction course which will be offered on the voyage enroute will in itself give the doctor:

(1) An opportunity to acquaint himself with the fundamentals and practical experiences of recognized specialists. This means that it is

not absolutely necessary for one previously to have had any experience with the use of physical agents.

(2) An intensive and thorough review course in every branch of electro-physical therapy as employed in all the various specialties of medicine and surgery.

The visits at the various hospitals and clinics in the prominent cities of Europe and the personal contact with the clinicians who have developed physical therapy will tend further to augment the preliminary instruction work. All in all, this combined and systematized method of offering such an intensive plan should indeed be an attraction to every physician. THE AMERICAN COLLEGE OF PHYSICAL THERAPY is very glad to offer this means to its fellows and other physicians who are interested in physical therapeutics.

\* May 26. Sail from New York.

June 4. LONDON.

June 5. PARIS:

Sal Petre & American Hospitals.

June 6. Prof. D'arsonval's clinic.

June 7. Dr. Riviere's Clinic; Hotel Dieu.

June 8. Guests of Soc. Electrotherapy

June 9. and Radiology of France.

June 10. LEYSIN:

June 11. Prof. Rollier's clinic.

June 12. ZURICH: University of Zurich.

June 13. VIENNA:

June 14. Dr. Kowarchik's clinic.

June 15. Allgemeine Krankenhaus.

June 16. Kaiser Jubiläum Spital.

June 17. Other clinics and hospitals

June 18. BERLIN:

June 19. Dr. Rudolf Verchow Krankenhaus

June 20. Dr. Nagelschmidt's clinic.

June 21. Other clinics.

June 22 COPENHAGEN:

June 23. Finsen Institute.

June 24. Dr. Carl Sonne's Laboratory.

June 25. ESBJERG: Enroute to London.  
 June 26. LONDON: Middlesex Hospital.  
 June 27. St. Bartholomew's Hospital.  
 June 28. London General Hospital.  
 June 29. Lord Trelor Hospital.  
 June 30. Sail for New York.

\*Above tour subject to change at discretion  
 of Director of Travel.

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## THE STUDENT'S LIBRARY

### BOOKS RECEIVED

This column is devoted to acknowledgment of the books received. Such acknowledgment must be regarded by the sender as sufficient recognition of the courtesy until time and space permit selections to be made for review.

**OBESITY.** By *Leonard Williams*, M. D., author of *Minor Maladies* and *Middle Age and Old Age*. Cloth, pp. 171, with 20 illustrations. Oxford University Press, New York, 1926.

**INTERNATIONAL CLINICS.** Vol II. Thirty-seventh series. Edited by *Henry W. Cattell*, A. M., M. D., with the collaboration of leading members of medical profession. Price \$2.50. Cloth, p. 308, with 72 illustrations. J. B. Lippincott Co., Philadelphia, 1927.

**X RAYS AND RADIUM IN TREATMENT OF DISEASES OF THE SKIN.** Second edition. By *George M. MacKee*, M. D., professor of and director of department Dermatology and Syphilology, New York Post Graduate Medical School and Hosp., etc. Cloth, p. 788, illustrated with 354 engravings and 31 charts. Price \$10.00. Lea & Febiger, Philadelphia, 1927.

**MINOR SURGERY.** By *Arthur E. Hertzler*, M. D., F. A. C. S., Chief Surgeon Halstead Hospital; and *Victor E. Chesky*, A. B., M. D., F. A. C. S., chief resident surgeon Halstead Hospital. Cloth, pp. 568, with 438 illustrations. Price \$10.00. C. V. Mosby Co., St. Louis, 1927.

**EMERGENCIES OF A GENERAL PRACTICE.** Second edition. By the late *Nathan Clark Morse*, A. B.,

M. D., F. A. C. S. Revised and rewritten by *Amos Watson Colcord*, M. D., surgeon Carnegie Steel Co., surgeon Pennsylvania Railroad System, ex-President Association Railway Surgeons, Pennsylvania Lines East, etc. Cloth, Pp. 541, with 311 illustrations. Price \$10.00. C. V. Mosby, St. Louis, 1927.

**PHYSICAL DIAGNOSIS.** Ninth edition. By *Richard C. Cabot*, M. D., Prof. Medicine Harvard University, formerly chief of West Medical Service at Massachusetts General Hospital. Revised and enlarged. Pp. 536, with 6 plates and 279 figures in text. Cloth. Price \$5.00. William Wood & Co., New York, 1927.

**BRONCHOSCOPY AND ESOPHAGOSCOPY—**  
 A manual of peroral endoscopy and laryngeal surgery. Second edition. By *Chevalier Jackson*, M. D., Sc. D., LL. D., F. A. C. S., Prof. Bronchoscopy and Esophagoscopy, Jefferson Medical College and Graduate School of Medicine, Univ. Pennsylvania; Consulting Bronchoscopist and Esophagoscopist, Jefferson Hospital, Univ. Pennsylvania Hospital, Woman's Medical College Hospital, Samaritan Hospital, Germantown Hospital in Philadelphia, and Presbyterian and Western Pennsylvania Hospital, Pittsburg, etc., etc. Cloth. Pp. 457, with 179 illustrations and ten color plates. W. B. Saunders Co., Philadelphia, 1927.

## BOOKS REVIEWED

**PRACTICAL PSYCHOLOGY.** Human nature of everyday life. By *Edward Stevens Robinson*, Associate Professor of Psychology, University of Chicago. Pp. 479 with 54 figures. New York: Macmillan Co., 1927.

To present the subject of psychology as a science within itself, there is very little to be gained for the medical student. In his future studies of the normal and abnormal actions and activities of human nature, the intricate psychological processes are not necessarily applicable. It is necessary, however, before he can appreciate the psychiatric abnormalities that he have definitely established the normal psychological processes. Habits, their acquisition, perception, ideation and feeling constitute the material for discussion. This is done in such a simple manner as to render the reasoning plain to those who have not had previous psychological training. To the reader such a text as the one under consideration should be a valuable preliminary study in preparing this foundation.

**HUMAN PHYSIOLOGY.** *John Thornton*, M. A. Third edition. Completely revised by *William A. M. Smart*, M. B., B. Sc. Lond., M. R. C. S. Eng., L. R. C. P. Lond., Dept. Physiology, London Hospital Medical College, Univ. London. Price \$3.75. Pp. 463 with 281 illustrations. New York: Longmans, Green & Co., 1926.

One of the standard textbooks of physiology, this book has been completely revised and brought up to date for the medical student. The original, simple, clear style has been maintained in presenting to the second year student the fundamental principles of physiology. It is not an easy task to correlate the work of the first year with that of the second. It is not an easy task to enliven the cadaver of the dissecting room; but in the presentation of the essentials of physiology in this text the author has done much towards reconstructing the body and breathing life into the inanimate.

The subject matter has been presented anatomically. By systems the physiology is given. The elementary

basic facts are detailed in a manner essential for the establishment of medical students' foundation. It would be a valuable addition to the armamentarium of any second year student and would be a valuable review for any senior or practitioner.

**PRACTICAL OTOTOLOGY.** *Morris Levine*, M. D., Assoc. Prof. of Otology, New York Post Graduate Medical School. Pp. 385. Illus. Cloth, \$5.50. Phila.: Lea & Febiger, 1927.

This is a treatise practical in its entirety, of the various phases of otology. For the student it should prove invaluable. For the practitioner and specialist, it is an excellent reference volume.

Although brief in a sense in some parts, there is much to be commended in the style and systematic arrangement of the material. It is simplified in these respects and easy of access for ready reference.

The advocacy of diathermy for some of the acute ear infections needs some further consideration and plainly shows that the author has been misled by some unauthentic literature. Diathermy must be used with caution in acute ear disease and only after proper and adequate drainage has been established. It would have been well for the author to have emphasized these points rather than just to mention the use of diathermy in a general way.

In all, however, there is much more mention of the value of physical agents than in other recent books on otology. No desire is had, however, to criticize the fact that methods in this connection as mentioned are in several instances faulty. It is quite certain that later editions will bear corrections along these lines.

The reviewer wishes to commend the book to all who wish a concentrated treatise or practical advice in otology.

# INTERNATIONAL ABSTRACTS

**Roentgen Therapy of Inflammatory Diseases in Gynecology. Wagner Zentralblatt für Gynakologie, No. 2, 1927. Abstract—in Fort. der Med., No. 3, 1927.**

Weak Roentgen irradiation is indicated in the inflammatory diseases of the upper genital tract: Peritonitis, Douglas exudate, pelveo-peritonitis and inflammations of the adnexa of various etiology: gonorrheal, puerperal, tuberculous and of unknown etiology. With correct technique and dosage there is often a rapid improvement of the general condition, with a decrease or disappearance of pain, and an objectively demonstrable fall in temperature and characteristic changes in the blood picture including an increased bactericidal power. Sometimes changes for the worse occur, as they would with any method. In the evaluation of results, one must be aware that in many inflammations of the female genitalia, a complete recovery is only to be expected in exceptional cases, no matter what treatment is employed. The author comes to the conclusion that weak Roentgen irradiation should be considered as equal in value to other methods. Since the number of rays to reach the ovary is far below the harmful dose, the effect of irradiation is rather a stimulus to increased function than an injury.

**Roentgen Ray Burns and Ultra Violet Light in Lupus. Felice Diana, Raggi Ultravioletti, 5-6-1926. Abstract—Fort. der Med., No. 34, 1926.**

The author always irradiates with combined Roentgen and ultra violet rays. He reports two cases in which he cured x ray burns by ultra violet light. Plan of irradiation: Three times a week beginning with small surfaces which are gradually increased. The distance of the lamp starts with 70 cm. and comes down to 40.

**Abortive Treatment of Acute Coryza by Diathermy. Dr. Tsinonkas. Archives D' Electricite Medicale, No. 525, 1927.**

The author has been led to apply diathermy in the treatment of coryza by observing the good effects of steam inhalations on patients suffering from this disease.

Cylindrical electrodes are most suitable. The electrodes are placed on the soft parts of the exterior of each side of the nose. The patient, himself holding each electrode, is placed comfortably in a chair. After ten minutes, the current having reached an intensity variable with the patient, 500 ma. on an average, the patient is told to raise the electrodes gently along his nose without changing his position. The nostrils are cleared and the patient is asked to breathe. Usually the patient already acknowledges an improvement.

The treatment lasts 20 to 25 minutes. A single treatment is sufficient, if there does not exist any chronic changes of the nasal fossae, polypsi or hypertrophy of the turbinated bones, etc. After the treatment the respiratory difficulty disappears and sneezing ceases, mucous secretion is drained and the patient confesses to a remarkable well being. Patients with a stronger attack of acute coryza can bear a more intense current than patients with a lighter attack. A medical application of diathermy makes possible the discovery of anatomical lesions among patients who believe themselves suffering from simple coryza, and to direct them to a specialist in oto-rhino-laryngology.

The author has also observed that patients cured by diathermy who before that suffered intensely from coryza at each change in temperature, seemed after the treatment to be almost refractory to that affection.

**Appearance of Vitiligo Patches Following an Erythema Produced by Ultra Violet Rays. (Artificial Sunstroke). M. E. Juster, Journal De Med. De Paris, No. 17, Apr. 28, 1927.**

While treating by ultra violet rays and diathermy, a 60 year old patient suffering from intermittent claudication as a result of arteritis obliterans of the lower limbs, sun stroke occurred at the fifth treatment. At the end of the erythema, which lasted 4 to 5 days, achromatic patches, surrounded by a zone of hyperpigmentation, appeared progressively on both limbs. The patient gave a history of syphilis. The author sees in the appearance of the vitiligo an indication of modification of cutaneous nutrition which had already been disturbed by vascular sympathetic disorders of which the patient suffered. The modification is due either to



vaso motor disturbances of the erythema, or rather to the toxic processes following the light burning by the rays. This patient, having already had vitiligo before, presented a particular fragility of his pigment cells. Syphilis is an etiological factor in the neuro-humoro-circulatory toxic disturbances which govern and modify cellular life of the skin and its appendages.

**Roentgen Ray Therapy in the Realm of the Nervous System. R. Lenk, Wiener Klin. Wschr., No. 20, May 19, 1927.**

This is a review of the favorable effects of Roentgen ray therapy on brain tumors. However only gliomas and sarcomas are affected and not cysts, fibromas, psammomas, gummas and tubercles. All hypophyseal tumors are influenced favorably except cysts and teratomas. Thus successful results are obtained in carcinomas, sarcomas and adenomas of the anterior lobe. Roentgen rays affect syringomyelia in the state of exuberance, habitual headache, (not real migraine), angioneurotic diseases (parasthesias, intermittent claudication, Raynaud, Trophic ulcers,) tabes dorsalis (especially symptomatic effects on lancinating pains, gastric crises), as well as nervous disturbances in hyperpituitarism and hyperthyroidism. Successes are also reported in psychic diseases. Thus favorable results are obtained in nymphomania. Inflammatory diseases in the peripheral and central nervous systems, in recent stages, are also successfully affected by Roentgen rays (trigeminal neuralgia, spinal and cerebral infantile paralysis, encephalitis lethargica).

**Organization of Instruction in Roentgenology and Electro-physical Medicine in France. Karplus, Deutsche Med. Wschr., No. 18, April 29, 1927.**

The purpose of the instruction is to teach students and French and foreign doctors the theoretical, practical and clinical knowledge in radiation and electrolgy. The courses are given in the Radium Institute and Medical Faculty. Instruction embraces: I. Preparatory courses; II. Advanced Specialization Courses.

Course I. Time 6 months. For physicians and advanced medical students. Divided into 3 parts.

Part 1. Physics of Roentgen rays. Technology. Roentgen diagnosis. Discharge in gases. Ionization. Fundamental properties of Roentgen rays. Secondary radiation. Roentgen tubes. Measuring methods. Apparatus. Radioactivity and radioactive bodies. Roentgen diagnosis.

Part 2. Physiology of radiation. Roentgen therapy. Curie-therapy. Biological effects of Roentgen rays and radioactive bodies. Therapeutic technique in

the use of Roentgen rays and radioactive bodies. Radiation therapy of cancerous diseases. Radiation therapy of non cancerous diseases. Injuries from radiotherapy in general.

Part 3. Electrolgy. Light therapy. Physics of the currents used in electrolgy. Electrophysiology and clinical electrodiagnosis. Electrotherapy. Electricity accidents. Biology of light. Light therapy. Ultra violet radiation, etc.

II. Specialization course. Duration 2 years. It embraces four semesters which are given in certain specially qualified clinics. The student writes a thesis and passes the required examinations at the end of his course. He then receives a diploma in Radiology and Medical Electrolgy from the University of Paris.

**On the Effect of Roentgen Rays on Cells. Prof. W. Scholtz, Deutsche Med. Wschr., No. 16, April 15, 1927.**

On the basis of histological investigations of the irradiated skin of rabbits, young pigs and human beings, the author finds that Roentgen rays affect primarily the cellular elements of the body. The inflammation resulting from Roentgen irradiation is only of a secondary nature. The biological effects of Roentgen rays are as follow:

1. The chromatin network of the nucleus serves as the primary point of attack of the Roentgen rays. The injury of the nucleus from mild irradiations consists in a temporary inhibition of the power of the cell to divide. There is a destruction and death, especially of the resting cell, only after very intensive irradiation.
2. Protoplasm and function of the cell are not apparently injured by mild irradiations.
3. There is no latent period in the effects produced on the cell by Roentgen rays, as there is clinically.
4. The Roentgen rays do not appear to have any irritation effect on nuclear division, nor on cell function.
5. Chemical changes of the nuclear substance of irradiated cells are not demonstrated by vital staining and the nuclear reaction. However the chromosomes, at cell division, stand out beautifully and distinctly with the nuclear reaction, and this reaction is therefore useful in studying the Roentgen effect on the nucleus.

**Treatment of Goiter and Thyro-Toxic Symptom Complex Including Basedow's Disease with Radium (Mesothorium) Irradiation. Prof. Gudzent and Kussat, Deutsche Med. Wschr., No. 20, May 13, 1927.**

Technique for new formations: About 100 mg. of radium (in the form of any radium salt) or an equally

strong mesothorium mass, is equally divided among 6 tubes 1.2 cm. long. These are to have the B radiation filtered in a 1.5 mm. thick Messing tube, and then are to be fastened on cork or rubber blocks of about 1 cm. thickness. A rather thin sheet of cotton is placed as a foundation on the glands to be irradiated, and on this, uniformly distributed, are 4-6 blocks which are held firmly on the cotton foundation. Above this is placed a thicker layer of cotton which further supports the blocks. A gauze bandage then gives the entire irradiation apparatus sufficient support. The irradiation lasts 24 hours.

The following results were obtained:

I. Goiter. 45 cases were treated.

Summary of 26 cases which could be controlled.

(a). Irradiated once.

17—Goiter disappeared.

2—Insignificant rests remained.

1—Decrease in size.

7—Good results in the beginning; 6-12 months later relapse.

1—No improvement.

(b). Irradiated twice. 9 cases.

6—Goiter disappeared.

3—Slight rests remained.

II. Thyro-toxicoses.

33 cases of thyro-toxicoses were treated. 13 cases were under observational control.

Summary of 13 controlled cases.

(a). Irradiated once.

6—Cases, 5—healed.

2—slight relapse after 12 to 18 months.

1—considerable improvement.

(b). Irradiated twice.

7—Cases, 4—healed.

1—A relapse after 1½ years.

1—Considerable improvement.

2—No success; relapse after short time.

III. Typical Basedow.

29 cases. 13 cases available for statistics.

Summary of 13 controlled cases.

(a). Irradiated once.

8—Cases. 5—healed.

3—slight nervous difficulty remained (tachycardia).

(b). Irradiated twice.

4—Cases. 3—healed.

1—Slight nervousness remained.

(c). Irradiated 3 times.

1—Case, cured (tachycardia remained).

There was no injury nor any considerable skin reaction in any of the 29 irradiated cases. The authors come to the conclusion that the best treatment for Basedow's disease is irradiation with Roentgen or radium rays. Radium radiation is preferred and surgical treatment is set aside as a method of choice. An operation should only then be attempted when the impending unfavorable course of the disease justifies this attempt. Operation is the method of choice in goiter without evident thyro-toxic symptoms. The thyro-toxicoses should be irradiated when other internal therapy was without success.

**A Case of Whooping Cough at the End of Pregnancy Healed with Roentgen Rays. Dr. Zoltain V. Hrabovsky, Wiener Klin. Wschr. No. 13, March 31, 1927.**

A three weeks catarrhal state in a seven year old girl was followed by strong typical attacks of whooping cough. The number of spasms rose the first day to 30. On the second day of the convulsive state, a liver irradiation was made. The patient received a dose of 250 R. through a 3 mm. aluminum filter. The author applies a dose of 200 to 300 R. after 7 to 10 days according to the circumstances, taking the general reactions under consideration. The girl recovered rather quickly from the head ache caused by the Rontgen rays. Another irradiation followed after 6 days, and the girl was completely cured.

The mother is in the ninth month of pregnancy, and suffers for the last two years from bronchial asthma. She contracts whooping cough the same time as her daughter. After other methods failed, the success obtained with Roentgen rays exceeded all expectations. The disease process declines and disappears within two days after the irradiation.

The author considers his method of liver irradiation not only indicated in children, but also in the whooping cough during pregnancy.



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